THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE NEW RULES FOR ELECTRICITY IN MINES.

AN action involving very important issues was brought by the Home Office against the Consett Iron and Coal Co., and was reported in our issue of August 2nd. As may be remembered, a fatal accident at one of the above-named company's collieries resulted in the death of a workman employed in working a face conveyor. As a result of this the Home Office instituted proceedings against the manager for not having the switch efficiently earthed; had this been done, it would undoubtedly have saved the poor man's life. The Consett Co., however, defended the case, and maintained that under the new rules, No. 20, sub-section (*b*), exonerated them from any liability to earth their installation, as it was in accordance with the old rules and was erected before June 1st, 1911.

Whatever the position may be from a legal point of view, it is, if we rightly understand the facts of the case, rather pitiful that a powerful and wealthy concern like the Consett Iron and Coal Co. should try to avoid rules which were designed, not to annoy proprietors of coal mines or to cause them unnecessary expense, but to reduce the risk of accidents and safeguard the lives of the workmen employed by them, and their own property from destruction. One would have thought that colliery companies would have welcomed anything in the shape of rules and regulations which had this object in view. We are not defending the Coal Mines Regulation Acts, or even the new Electricity Rules, but merely the humanitarian object with which they were originally framed, and no one who knows the extreme carelessness with which, in many cases, electrical installations were installed underground and managed afterwards—criminal carelessness we should be inclined to call it, were it not for the excuse of ignorance of electrical matters on the part of those responsible—will for one moment deny that some such rules were required. How many lives, we would ask, have been sacrificed to the ignorance of those in charge of the plant, and the defiance of all rules and regulations? One need only turn over the pages of the Inspectors of Mines' Reports, and total up the number of fatal accidents—most of which might have been avoided had a little common-sense been exercised in the installation and management of the plant—to be appalled.

How often have we dealt with this question in our own columns, and pleaded for common-sense methods of handling electricity in mines, and the abandonment of a cheese-paring and defiant policy. How often again have we pleaded for the employment of trained engineers, with full responsibility for the plant they have charge of. We repeat that we hold no brief for Home Office Regulations, but we do for electricity, and it is of its misuse and mismanagement that we complain. Rightly installed and rightly used, it will give mine-owners the best return of all the capital expended in the equipment of the mine; and, moreover, it is as safe and as reliable as either steam or compressed air, but vastly cheaper to install and much more economical to work.

Returning, however, to the case in point, we have before us the Report of the Departmental Committee which drafted the new rules, and which says regarding the earthing of metallic coverings of apparatus (see page 9) :—"The Committee regards a sound connection to earth for all metallic coverings and casings, whether the apparatus be fixed or portable, as the best safeguard against shock that exists in underground conditions. The existing rule (No. 1*c*) makes two exemptions—(*a*) in favour of portable machinery (including trailing cables) and (*b*) in favour of low-pressure systems. The Committee recommends that exemption (*a*) *be withdrawn altogether*; and that exemption (*b*) be modified in the case of alternating-current systems, so that earthing is required where the pressure in a system exceeds 125 volts." The italics are ours, and we wish to emphasise what was evidently the view and intention of the Committee that, so far as Rule 1*c* sub-Section (*a*) was concerned, this was to be withdrawn absolutely on the date the new rules came into force. Further, Mr. W. C. Mountain, in his evidence before the Committee (see Minutes of Evidence, page 73, Q. 2,437), said in reference to Rule 1*c* :—"It appears desirable to modify this rule so that the frames of portable machines, such as coal cutters, portable haulages, compressors, motors, and machinery which is not definitely fixed upon foundations, shall be *efficiently earthed, together with the metallic cases containing the switchgear*," and we must point out that Mr. Mountain was speaking as a member of the Advisory Committee of the Coal Owners' Association of Northumberland. It is true Mr. Mountain to some extent qualified this statement—if qualification it can be called—by explaining that some collieries had successfully worked electrical machinery for 10 or 12 years without accident by merely relying upon the perfection of the insulation. "If," said Mr. Mountain, "such a degree of insulation could be maintained, of course I think earthing would not be necessary. But I am afraid there is a big 'if.' If some of these days a breakdown did occur, somebody would be killed. They are sitting rather on a powder magazine, I think." From this we gather that evidently Mr. Mountain thinks the rule is justified, and in our view it seems paltry to seize upon a legal interpretation of a clause in the Act to avoid or shirk responsibility, especially when all the facts and all expressions of opinion from experienced electrical engineers go to prove that the switch box in question *ought* to have been earthed. It has been said that the case turned upon the correct reading of the exemption clause and not in any way *upon expense*. We cannot agree with this view, for had there been any desire on the part of the colliery company to meet the intention of the new rules they would have put in a temporary earthing system, and what other objection can there be to fulfilling the requirements of the rule before the year 1920 except that of expense?

As regards the legal decision, the magistrates gave their verdict against the Home Office, who asked for a case to be stated, and as a consequence, seeing the case is still *sub judice*, it would not be proper for us to express any opinion. What does concern us though is the effect that the ultimate decision of this case may have upon colliery owners, for if the magistrates' decision be upheld, installations which ought to be attended to at once, and in which proper provision should be made for efficient earthing, will receive no attention under the plea that there is plenty of time, whilst all the time workmen are risking their lives, and electricity is earning a bad reputation. An honest man has no fear of the law, and in the same way we think colliery managers would be well advised carefully to examine the rules, and at once to set about bringing their installations into conformity with them. Accidents, especially when fatal, are not to the credit of colliery managers, and are expensive to the owners. The rules are designed to prevent accidents, and in our opinion they ought at least to be met in the spirit with which they were drawn up. Our sympathies are with Mr. Imery, manager for the Consett Co., as well as all other colliery managers, inasmuch as they have too many responsibilities upon their shoulders in the efficient management of a coal mine, but until they themselves see that it would be to their own relief and advantage to have the mechanical and electrical responsibility transferred to properly-qualified engineers, there is little hope of any change. Meantime we muddle along, and a lot of time seems to be wasted in seeing just how few of the many requirements under the numerous rules and regulations applying to coal mines may be made to serve, and in siezing upon exemption wherever possible, merely because it will relieve them from being obliged to do something, without giving the slightest thought as to whether that something is worth doing or not.

The Design of Machinery.

The Diesel explosion at Bray may be taken to heart by all machinery designers as an illustration of the inevitable fate which must eventually overtake all machinery in which some necessary safeguard has been omitted. In an ordinary crab winch, so long as the men at the handles are constantly on the alert and there is no sudden jerk to take the handles out of their charge, there is really no need for the ratchet pawl, whose resounding click makes known the fact that there is an automatic safety device on the watch against disaster. The ratchet in some form or other is a very common device in engineering. It is used in lifts, though it has become in these rather a grip brake than the suddenly acting ratchet it once was, which would act safely on a rising cage, but probably would do no good on a descending one, though a rope is more likely to break when a cage is descending if there are stops to be made on the way down.

A boiler feed-pipe without a check valve close up to the boiler may be a cause of low water and collapsed furnaces, but the check valve is never omitted now. The designer of Diesel engines intends that the air cylinder for the blast shall always carry a higher pressure than the engine cylinder, but evidence seems to be accumulating that this is not always the case. In this connection, it seems a pity that the small explosions that have occurred have not been more prominently recorded, their causes found out and explained, and an endeavour made to follow them logically to their possible worst results. Had this been done, it is possible that non-return valves, such as we have suggested, would have formed ere now a regular feature of design. It seems quite natural to suppose that serious mischief could not travel along a $\frac{3}{8}$-in. bore of some considerable length; but one of our correspondents has known this to have taken place some time ago, and his knowledge, if it had been published and had reached the right quarters, might have prevented the Bray explosion. Designers should always be on the alert to guard against the effects which may follow when pressures vary in any piece of apparatus. It is best to design such apparatus to work as it is desired to work, and then to assume that the pressures will, by some unknown means, vary from what they should be, and to follow out all imaginary consequences and to provide against them. It is not always that consequences are serious, but they are often inconvenient.

When putting in safeguards, it is most necessary to be sure that in cutting out one risk another has not been introduced of equal danger. Certain forms of isolation valve are fraught with danger, because they are afforded too long a movement in which to receive acceleration and acquire dangerous momentum. Wherever fluids can, under certain accidental circumstances, go the wrong way there may arise trouble or danger, and the non-return valve, which is, after all, only a form of ratchet, must be applied. It is the business of a designer to think out these possibilities, and not simply to design on the assumption that the matters he has arranged are going to act as they ought to do. It is easy to make these omissions, unless a special study is entered upon by supposing failure to occur and tracing its results.

The Reform of Railway Statistics.

One of the dubious joys of whole-hearted identity with any particular reform movement lies in the certainty of the fact that the reformer never gets really all he wants. There may often be very good ground for his inevitable dis-

content thereat. Mr. W. M. Acworth (who, with Mr. George Paish, was responsible for the authorship of a paper read a short time ago before the Royal Statistical Society on "British Railways; their Accounts and Statistics") is in the position of a partially satisfied reformer. For many years Mr. Acworth has worked for the publication, *inter alia*, of passenger mileage and ton-mileage statistics on our railways. The Board of Trade returns in regard to British railways have long been recognised as notoriously unsatisfactory. We have, from time to time, referred to the matter in these columns. Last year Parliament managed to pass a "Railway Companies' (Accounts and Returns) Act." This Act, to which we made brief reference in our last issue, throws some sort of a sop to the statistical reformers by its drastic amendment of the returns as to allocation of capital outlay and sources of revenue. It is not so satisfactory with regard to the returns giving the cost of maintenance and renewal. On the electric traction side, it is decidedly weak. For instance, the item "Electric Power Stations, &c.," in the capital account may include under the &c. the lighting of stations, or even sub-station equipment. But where are we to look for details such as the cost of, say, overhead equipment or live rails or special rolling stock or cables? As regards the maintenance and renewal of way and works (Abstract A), not one of the 20 headings seems suitable to cover maintenance of outside electrical equipment. Abstract B, which is concerned with the "maintenance and renewal of rolling stock (1) locomotives," contains no differentiation in respect of steam and electric locomotives for railways owning both types.

It is true that Abstract C, under "locomotive running expenses," contains the sub-heading "Electric train working," the items of wages of motormen, cost of energy, lubricants, and other stores, including clothing. Schedule No. 17, however, is entitled "Electric Power and Light Account." The main defect of this schedule is that there is no differentiation between the costs of lighting and traction. It is true that separate returns of the energy supplied give this under four headings, viz., Traction, Power, Lighting and "Other consumers." No particulars are given of rated capacity of plant installed, or of load factors.

Statistical Returns, Part (2), Sec. (2), Sub-Sec. (C) relates to the "Trains worked by electric power." This, while very brief, is hopeful. It is as follows:—

Details to be filled in as instructed by the Board of Trade from time to time by individual companies with regard to the various systems in use.	*Number.*	*Carrying capacity. Seats.*

On the maintenance and renewal of rolling stock, Part 2, Sec. (11), Abstract B, we have the serious mistake of combining "rail motor and electric" rolling stock, and the proposed publication of the numbers renewed, received heavy repairs, received light repairs, and under or awaiting repair at the end of the year, with the further sub-division of the numerical figures into the two classes of repaired in the company's workshops or "by contract."

We feel that the omission of specific information with regard to ton-mileage, average distance hauled per ton, passenger mileage, average distance travelled per passenger, average number of vehicles per train, ratio of tonnage carried to wagon capacity, and ratio of passengers carried to seat capacity, is a very serious matter. It is not beyond the wit of man to secure such data. They are the distinctive features in the administrative returns of many leading railway systems. It is rather strange that the country in which railways originated, and which administers the railway systems of our Indian Empire in a manner not surpassed by even German capabilities of analysis, should slur over the compilation of British railway returns by leaving them notoriously incomplete. It is neither fair to the manufacturing community nor to railway shareholders. Electrical engineers whose central station returns are so carefully compiled, and so capable of strict analysis, may well sympathise with those who are pressing for exactitude and utility in railway statistics. It is good that Mr. Acworth (himself a railway director), and those supporting him, are not sitting still under a partial success. On the success already attained congratulations are due, and with these we must tender good wishes for the further success which is necessary.

CABLE DISCOUNTS.

By H. R. TAUNTON.

A change in the C.M.A. discounts, such as has recently been notified to the trade, brings in its train a fresh crop of arithmetical puzzlers for the users of cable catalogues, who find all their net prices, laboriously calculated for the old set of discounts, rendered obsolete. New net prices have to be worked out; and to deduct three successive percentages from a given list price, and to reduce the result to shillings and pence, and to coils and yards, is a figuring feat that would daunt a calculating machine, let alone a busy contractor. And he generally forgets to make a note of the result, so that a week later he has the wearisome task to face again for the same size and grade. When this labour is multiplied by 50 different sizes of cable, and a score of different grades, it will be seen that the C.M.A., in changing their discounts, unwittingly entail on their customers an amount of pencilling of paper and sliding of rules that, properly applied, would produce half-a-dozen volumes of Institution Papers.

It is with the idea of minimising this waste of valuable brain power that the following short cuts are suggested. They will be found to give results considerably more accurate than those of the slide-rule, and quicker than paper and pencil; contractors especially should find them useful:—

C.M.A. Grades.

Net price in pounds per mile:—

Multiply list price by 6. Multiply the result by 2. Add $\frac{1}{10}$ of the first figure to $\frac{1}{1000}$ of the second figure.

Net price in shillings per coil:—

Add half the list price to $\frac{1}{100}$ of the list price, and increase the result by one-half.

Net price in pence per yard:—

Add half the list price to a third of list price, and divide the result by 10. (This gives a result accurate to $\frac{1}{80}$ of a penny for a list price of £100, or $\frac{1}{8}$ of a penny for a list price of £1,000, which is sufficiently close for practical purposes.)

Non-Association Grades

Net price in pounds per mile:—

Add two-fifths of the list price, divided by 10, to half the list price.

Net price in shillings per coil:—

Add half the list price to a half of that, and subtract one-tenth of the result.

Net price in pence per yard:—

Add half the list price to a half of that, and subtract one-fifth of the result. (This, as in the corresponding case for C.M.A. grades, is not absolutely exact, but sufficiently so for practical purposes.)

Tabulated for convenience of reference, these results read as follows, L being list price:—

Net Prices of Cable at Current Discounts.

C.M.A. £ per mile $= 6\,L/10 + 2 \times 6\,L/1{,}000.$

s per coil $= L/2 + L/100 + \frac{1}{2}(L/2 + L/100)$

d per yard $= (L/2 + L/3) \div 10.$

"Non." £ per mile $= 2\,L/5 \times \frac{1}{10} + L/2.$

s per coil $= L/2 + L/4 - \frac{1}{10}(L/2 + L/4).$

d per yard $= L/2 + L/4 - \frac{1}{5}(L/2 + L/4).$

The above formulæ could easily be written in more compact forms, but they have been so expressed as to substitute, as far as possible, additions and subtractions and shifting of the decimal point, for multiplication and division. What little multiplication and division has to be done is effected by simple factors in easy stages.

In this connection it may be useful to remember that a price in pounds per mile can be reduced to shillings per coil by multiplying by $\frac{5}{4}$; and to pence per yard by multiplying by $\frac{3}{22}$. And again, shillings per coil can be approximately reduced to pence per yard by dividing by 9.

ELECTRICITY SUPPLY IN SHEFFIELD.

It is hardly necessary to descant upon the enormous potentialities of electricity supply in Sheffield. As a centre of every class of engineering and metal working, the city stands unrivalled in situation, development and prospects. The population is increasing with extraordinary rapidity, and is now close upon 455,000. The trade depression of ten years ago has been succeeded by a great industrial boom, and there is every reason to believe that the Corporation Electricity Department will now reap the full benefit of its persistent efforts and foresight during past, less favourable, periods.

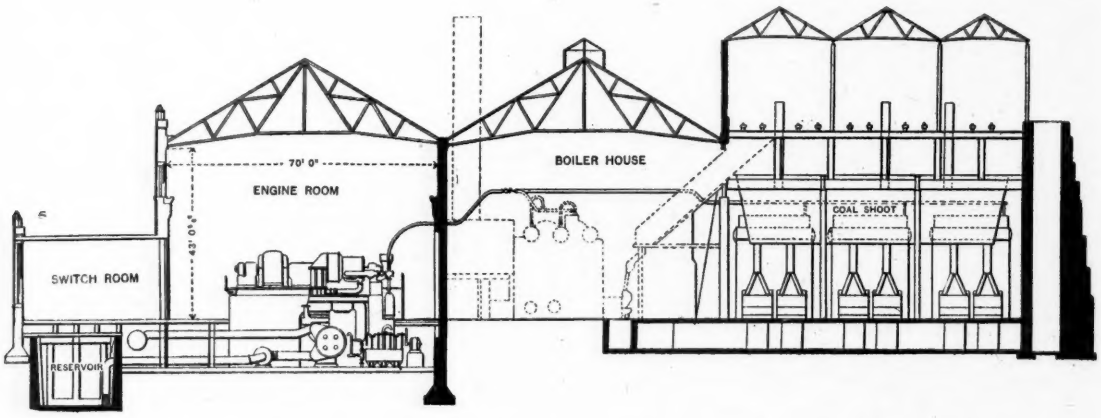

Fig. 1.—Sectional View of the Neepsend Electricity Works through the New Boiler House.

Until 1899 the system of generation was single-phase, 100 cycles, 2,000 volts, with transformer sub-stations and consumers' transformers, but, by this date, the demand for industrial electric motors had become such that 50-cycle, 2,000-volt, two-phase generators were installed, and the last turbo-alternator installed at Neepsend was (and all future extensions will be) for the supply of three-phase, 50-cycle current.

The original plant at Sheaf Street was described in detail in the Electrical Review of July 15th, 1904.

Owing to the insufficiency of condensing water, it was realised that the capacity of this station could not be further increased while maintaining low generating costs, and this led to the Neepsend development.

Ultimately the Sheaf Street works will be no more than a transformer sub-station, but at present it is called upon to help the Neepsend plant over its peak load. During winter months the Sheaf Street plant runs from 7 a.m. to 11 p.m.; normally the station is shut down during the summer (except for transforming purposes), but last year the load increase overtook the plant extension at Neepsend; hence the Sheaf Street plant was worked at full capacity throughout the summer.

The Neepsend station is located 2 miles from the centre of the city and 3·5 miles from the chief power loads (at the east end of the city), but such comparatively small transmission losses as occur under the high-tension distribution system adopted, and the high investment in feeders and distribution mains (£27 per kw.) are compensated and justified by the great natural advantages of the site.

Ample circulating water is available from the River Don, which is here, above the city, comparatively pure. Excellent rock foundations are available below a deep layer of clay, which, as it is excavated, is made into bricks to be used in the station buildings and retaining walls, &c. Railway sidings run along the hill side above the works, and as the latter are built on the excavations at river level, thus arrive level with the bunkers above the boilers; the rail level is 63 ft. above the boiler house floor. Part of the site to the north of the station is now being filled in with ashes, to form future sidings. Fresh extensions to the south for future plant are justified by the value of the clay and rock removed for bricks and concrete ballast. By exchanging a small area of land with the railway company, the shape of the site will be greatly improved at its southern end, and its ultimate capacity lies between 50,000 and 100,000 kw. The space required for coal storage and cooling towers will probably determine the capacity of plant which can be accommodated.

The original equipment of the Neepsend works (totalling 3,000 kw.) has already been described and illustrated in detail. The extensions just completed have lengthened the engine room 110 ft., and added a tee-piece to the boiler room. Ultimately, the buildings to the north of the centre boiler aisle will be duplicated to the south, thus forming a symmetrical whole; at the same time the switchgear will be centralised in the room shown on fig. 1. The present dimensions of the engine room are 163 ft. × 70 ft. × 40 ft. high, and of the boiler room—old portion, 214 ft. × 70 ft.; new portion, 110 ft. × 83 ft. 3 in.

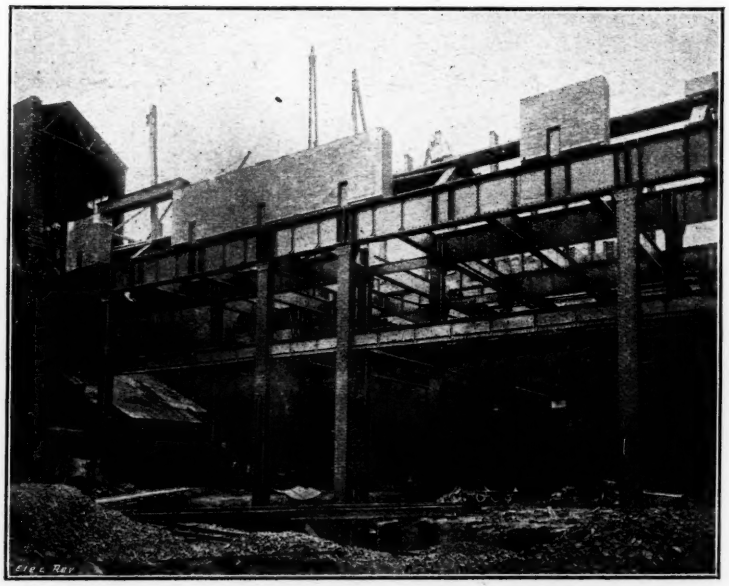

Fig. 2.—New Boiler House under Construction.

One of the most interesting features of the recent exten-

sions is the provision made for the storing of 3,500 tons of coal (roughly, six weeks' supply). Ample as this reserve would have been considered in earlier days, the national coal strike has shown how serious may be the effect of labour trouble on a public utility service, and the Electricity Committee is seriously considering whether eight weeks' supply should not in future be held. Apart from the space occupied by, and capital sunk in, very large coal stocks, there is a gradual deterioration in the thermal value of the fuel, and a more or less serious risk of spontaneous combustion.* During the recent coal strike the station was, like many others, compelled to purchase at excessive prices—once the three weeks' stock neared exhaustion.

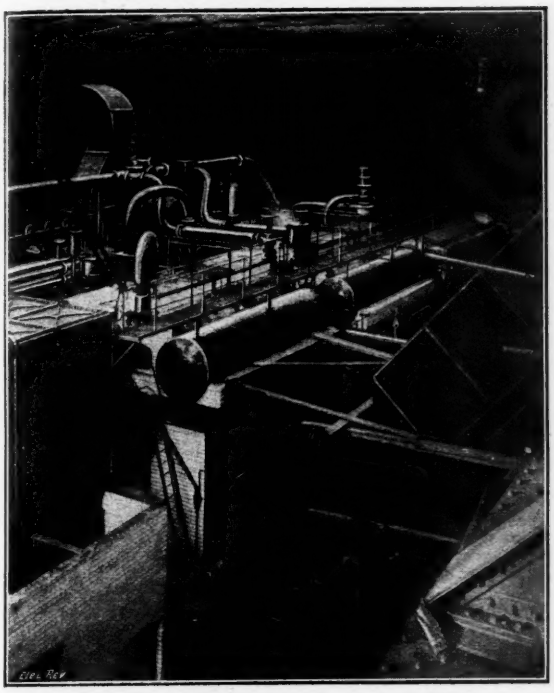

Fig. 3.—Old Boiler Plant, Neepsend.

Five sidings run directly over the new bunkers, into which coal falls through wrought-iron gratings (retaining any large pieces which might jamb in the coal shoots or valves). 9-h.p. capstans haul the trucks along the track over the bunkers, and a 9-h.p., 20-ton traverser enables wagons to be moved from one set of rails to another.

From the main store coal falls by gravity into inclined chutes (placed between the brickwork sections) and through breeches pipes and measuring chambers into the stoker hoppers. The coal consumption is initially determined by volume (the average weight of a measuring chamber full of coal of a given grade being determined by trial). The boiler attendant can only obtain coal by operating the measuring chamber valves (and incidentally the recorder) and these valves are so arranged that it is impossible to run coal continuously through the measuring chamber.

There are at present eight boilers installed in the older portion of the boiler house, and seats for six others are prepared in the new cross aisle. All the boilers are of the Stirling type, supplying steam at 200 lb. per sq. in. and 90° F. (Nos. 1-4), or 150° F. (Nos. 5-8) superheat. The principal dimensions are:—

	Nos. 1 to 4.	*Nos. 5 to 8.*
Heating surface, sq. ft.	6,210	8,016
Evaporation, lb. per hour	30,000	38,000

Boilers 1 to 4 have Bennis pneumatic stokers, Ellis-Eaves induced draught apparatus and the Fedden air heating boxes. Boilers 5 to 8 have chain grate and underfeed stokers, but although much less attention is required by these than by the older boilers, the latter show an appreciably higher thermal efficiency (3·0 lb. coal per kw.-hour, as compared with 3·1 lb. per kw.-hour, representing an annual saving of about 250 tons of coal). Nos. 1 to 4 have each a 45,000 cb. ft. per min. Sturtevant fan, delivering at 2·25 in. water gauge; Nos. 5 to 8 have each a 240-tube (10 ft. × 4·9 in. diameter) economiser; Nos. 5 and 6 are provided with a Sirocco induced-draught fan, and Nos. 7 and 8 with a forced-draught fan.

Isolating valves are fitted between each turbine and boiler and the main steam pipes (lap-welded wrought-steel, 7 in. and 10 in. in diameter), which run the whole length of the boiler house.

Steel smoke stacks (60 ft. × 5 ft. diameter for one and 86 ft. × 7 ft. diameter for two boilers) are employed; corrosion first occurs near the base and an average life of seven years is obtained. No firebrick lining is used and a coating of tar is given each spring.

For the removal of ashes, a narrow-gauge, hand-operated tramway is arranged immediately below the firing plates of the boilers, and this delivers to a "White" aerial ropeway, which finally dumps the ashes; this was recently described in our pages. From 10 to 15 per cent. of the coal fired is discharged as ash, and the operation of the ash tower occupies one man from 7 a.m. to 6 p.m. daily.

The new pump room is located opposite to the cross aisle of the boiler house, and above it is placed a 25,000-gallon feed tank, the level of water in which is indicated by a float gear and also by a head gauge, on the dial of which relay contacts are mounted to close an alarm circuit should the tank supply become excessive or insufficient. This precaution is found to be necessary owing to the tendency of the floats (as arranged), to wander about the tank, and also on account of their gradually becoming waterlogged.

A motor-driven centrifugal pump delivering 10,000 gallons per hour can be used to draw water from the river for feed or fire-extinguising purposes, in the event of a breakdown in the town supply. Its most common use is to supply river water to turbine tube-cleaners. Town water, which is very soft, is used for make-up purposes.

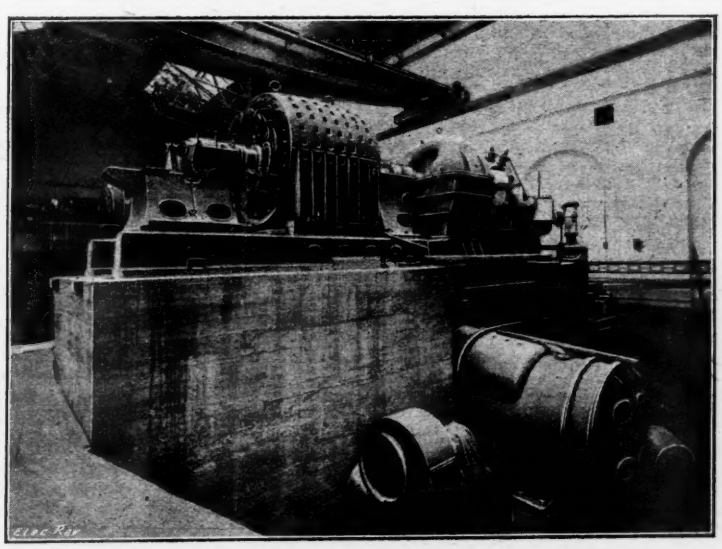

Fig. 4.—6,000-kw. Three-Phase Turbine Set being Erected.

In addition to the original two 1,500-kw., two-phase Parsons turbo-alternators, there have since been installed (parallel to the first units) a 4,000-kw., two-phase, and a 6,000-kw., three-phase set (both by Willans & Robinson-

* Electrical Review, June 9th, 1911, page 910.

Dick, Kerr), and both running at 1,000 R.P.M. Supply is at 50 cycles throughout, and at 2,100-2,300 volts from machines 1, 2 and 3, and at 11,400 volts from the three-phase generator (No. 4).

The leading dimensions and weights of the turbo sets now in operation are :—

	Nos. 1 and 2.	*No. 3.*	*No. 4.*
Length	34 ft. 6 in.	45 ft. 0 in.	46 ft. 6 in.
Width	7 ft. 6 in.	16 ft. 6 in.	14 ft. 6 in.
Height	9 ft. 0 in.	17 ft. 2 in.	18 ft. 6 in.
Weight of magnets; tons ...	17·5	28	50
„ armature; tons ...	8	15	25
Total weight: tons	45	93	112

The decrease in the space occupied and in the weight (per K.V.A. output) of the larger units is very remarkable. The No. 4 Neepsend turbine set—occupying 744 sq. ft. and 21,550 cb. ft. (overall and including auxiliaries)—has 1·7 times as great a rated capacity and 3·0 times as great an overload capacity as the whole of the Sheaf Street generating plant (which occupies 2,437 sq. ft. and 62,000 cb. ft.).

No. 4 set, though rated at 6,000 KW. (with natural cooling), will supply 8,000 KW. indefinitely and 12,000 K.V.A. for half an hour—the ventilating fan shown in fig. 4 being used on overloads. This unusually high overload capacity is very necessary in a rapidly growing undertaking, the chief demand on which consists of heavily fluctuating power loads.

Fig. 4 shows the No. 4 set nearing completion ; it was necessary to erect the main machine on a raised bed in order to accommodate the surface condenser and other auxiliaries in the basement, the floor level of which is only 2 ft. 3 in. above river level and cannot safely be lowered.

The total power required by the auxiliaries is about 66 H.P. for each of sets 1 and 2 ; 225 H.P. for No. 3, and 275 H.P. for No. 4. At present, two local sub-stations (one of 480 KW. and the other of 400 KW. capacity) supply two-phase, 200-volt current for the various auxiliary motors in the station and 100-volt current for lighting purposes. With the installation of the next generating unit (8,500 KW. rated output), the total power for auxiliary and lighting purposes will rise to about 1,200 KW., and one of the 1,500 KW. turbo-sets will then be employed on this load alone, the second similar set acting as a general reserve unit.

The condensers maintain a 93·5-95 per cent. vacuum, the inlet and outlet temperatures of the circulating water being 72° and 85° in summer and 42° and 50° in winter, and the temperature of the hot well discharge, 95° in summer and 80° F. in winter. Lea recorders are employed and the condensate flows through a recording Venturi meter, charts from which, together with boiler house and switchboard records, enable continuous supervision of the station performance.

Circulating water is taken from the River Don through a conduit 130 ft. long × 14 ft. wide, controlled by hand operated penstocks. The conduit discharges into a reservoir flanking the engine room and measuring 115 ft. × 20 ft. × 18 ft. 6 in. average depth. The maximum capacity of the reservoir is 250,000 gallons, and the average depth of water is 7 ft. 9 in. The reservoir is intended to act rather as a settling and suction tank than as a storage tank. Inclined screens with claw scrapers arrest and remove large *débris* from the water at the point of entry to the reservoir ; fine matter in suspension settles on the floor of the reservoir which undulates in four up and down slopes (1 : 24), with intermediate trenches, into which the sludge collects or is washed during the periodical cleaning of the reservoir.

The pumps on Nos. 1, 2, and 3 sets, draw from a basement duct supplied from the reservoir through 36-in. valves, but No. 4 set draws directly from the reservoir. In future units, it is proposed to employ siphonic circulation, and a new 220 ft. 48 in. diameter discharge pipe is being laid to the Don.

The original two-phase switchboard (described in our earlier article), has been extended by two-phase panels for set No. 3, and an extra-high-tension three-phase board has been built at the western end of the gallery. The three and two-phase systems are interconnected by four 2,000-KW. transformers arranged on the Scott tee-system. When further extensions become necessary, the switchgear and transformers will be removed to the new site shown.

From Neepsend, two-phase current is distributed at 2,000 volts through three pairs of 0·5 sq. in. concentric cables, while three-phase current is distributed at 11,400 volts between phases, through two 0·25 sq. in. three-core cables to the east end of the city. All the feeders are of the diatrine, paper-insulated, lead-sheathed type, drawn into cast-iron pipes, and their chief dimensions are :—

	Two-phase, 2,000-volt.	*Three-phase, 11,400-volt.*
Rated load, K.V.A.	1,000	3,000
Total length installed, miles	16	8
Copper, lb. per mile ...	43,622	17,746
Lead, lb. per mile	44,222	33,000
Overall diameter, inches ...	2·37	2·70

Owing to the smaller feeders required, the capital cost of the feeders has fallen from £10 10s. in the two-phase, to £2 10s. per KW. in the three-phase installation.

TABLE I.—Comparison of Typical Weekly Returns from Sheaf Street (3,500 KW.), and Neepsend (7-9,000 KW.).

—	Week ending June 14th, 1911. Sheaf St.	Neepsend.	Week ending December 20th, 1911. Sheaf St.	Neepsend.
Boilers—Number in use ...	8	5	8	5
Average hours steaming...	17	90	30	123
Average tons coal per boiler	15	100	22	128
Engines—Number in use ...	5	2	6	3
Average hours running ...	11·4	84·0	15·3	75·3
Units generated	28,870	316,700	50,150	506,500
Units used on works ...	499	18,603	930	21,988
Combined max. demand (KW.)	7,131		10,697	
Load factor (per cent.) ...	3·89	46·99	6·76	75·16
Coal consumed, tons ...	120	500	174	640
Water „ thousands gal.	127·4	167·2	193·5	105·0
Lb. water per KW.-hour ...	24·70	19·15	25·62	17·95
Lb. coal per KW.-hour ...	9·30	3·53	7·77	2·83
Lb. water per lb. coal ...	6·35	5·41	6·55	6·34
Works costs per unit generated (d).				
Coal and ashes	0·35	0·13	0·32	0·10
Water, oil, waste, &c. ...	0·08	0·00	0·04	0·01
Salaries and wages ...	0·24	0·05	0·16	0·03
Maintenance and sundries	0·06	0·11	0·10	0·04
Total	0·73	0·29	0·62	0·18

Sheaf Street and Neepsend Combined.

	June, 1911.	*Dec.*, 1911.
Thousands B.T.U. sold...	279·9	450·9
Estimated revenue	1,500	2,388
Cost of generation per unit sold :—		
Coal and ashes	0·18d.	0·15d.
Water, oil, waste, &c.	0·01d.	0·01d.
Salaries and wages	0·08d.	0·05d.
Internal maintenance	0·13d.	0·06d.
External maintenance	0·05d.	0·03d.
Rent, rates and taxes	0·07d.	0·04d.
Management	0·06d.	0·04d.
Total	0·58d.	0·38d.

This summary affords a most interesting comparison between the working of an old-fashioned station with low load factor and a modern station with very high load factor.

About 123 miles of high-tension and extra-high-tension feeders, and 131 miles of distributors are now installed (in a supply area of 37 sq. miles), and a total of 90 sub-stations supply more or less wide districts or individual large consumers. Low-tension distribution is at 410-205 volts, and standard sizes of sub-station transformer are 40,100 and 200 K.V.A. The largest "district" sub-station (at Chapel Lane), contains four 1,000-KW. 11,000-volt three-phase 2,000-volt, two-phase transformers, and supplies two-phase, and a certain amount of three-phase demand in the neighbourhood. Cubicle switchgear with separate panels and meters, &c., for large consumers, is erected in a room above the transformer chamber, and the ultimate capacity of the sub-station is about 8,000 KW.

(*To be concluded.*)

Wallasey Electric Lighting.—An inquiry will be held to-day (August 30th) relative to the application of the Corporation for sanction to borrow, among other amounts, £6,980 for electricity purposes.

NOTES FROM CANADA.

[FROM OUR OWN CORRESPONDENT.]

August 16th, 1912.

The little town of Campbellford, about 130 miles north-east of Toronto, situated on the Trent River, has lost an old landmark in the shape of a dam 60 years old, which was blown up recently. The dam was the means whereby about 1,000 H.P. was supplied to various mills, &c., on the river banks. Owing to the construction of the Trent Valley Canal, it was necessary to do away with this dam; at the same time, power is now available at other points, in larger quantities, and the Electric Power Co. has obtained the right to utilise the power at several such points.

As the Dominion Government is building the canal referred to, arrangements have been made for the Electric Power Co. to supply electricity to the various factories and works which have lost their water-power, but as, also, the town has recently built a municipal hydro-electric power plant, and is anxious to supply current, there is likely to be a protest made to the Government as to its agreement with the company, and the Hydro-Electric Power Commission has, it is believed, been asked to report on the whole situation.

A recently published report states that Ontario electric railways represent capital amounting to over £3,000,000. The Toronto Street Railway accounted for 17 persons killed and no fewer than 893 injured during 1911; apparently the people here are themselves very careless, as it is said that no one was "killed from causes beyond his own control, but 201 passengers and 53 employés were injured under these circumstances"—501 passengers suffered injury owing to their own carelessness.

In view of the electrification of the C.P.R. line from Rossland to Castlegar, B.C., next year, the plant of the West Kootenay Power and Light Co. will be much enlarged.

A rather unusual accident occurred a short time ago at a town in Alberta; the engine in the power house was struck by lightning and seriously damaged, and the town is likely to have no light for some time.

The city of Toronto is trying to arrange that all the large steamers which ply on Lake Ontario calling at Toronto shall be equipped with wireless telegraph apparatus, and it is understood that the Dominion Government will establish the necessary station on shore.

The Mines Branch of the Dominion Government Department of Mines, having for some time past made careful investigations into the question of the commercial possibilities of peat as a fuel, now considers the matter proved to its satisfaction and its work, in this particular direction, over; the rest will be left to private enterprise.

Two big peat plants are under construction, one at Alfred, Ontario, and the other at Farnham, Quebec; these are expected to supply Ottawa, Montreal and other places with cheap fuel. Whether peat will be used for power purposes remains to be seen; certainly, with all the vast areas of peat bogs which exist in this country, it will be surprising if nothing be done in this direction.

FAULT LOCALISING.

[COMMUNICATED.]

Some little time ago the writer had occasion to locate a "dead earth" on a ·25 sq. in. paper-insulated lead-covered traction feeder.

The instruments available were a "Raphael fault-localising bridge" and Messrs. Nalder Bros.' astatic galvanometer. In lieu of a battery, current for testing was drawn from the overhead trolley wire through two 250-volt 32-C.P. lamps (carbon filament) in series.

To complete the cable loop one of the overhead trolley wire ½-mile sections was brought into requisition with its line-feeder cables, but difficulty was experienced in determining the equivalent length of this portion of the loop, as the trolley wire was unevenly worn along its length; it is the object of this article to show how this was overcome.

The actual measurements were:—

Faulty feeder ...	908 yd.	× ·25 sq. in.
Line cables ...	35 yd.	× ·0976 sq. in.
Trolley wire ...	903 yd.	× ·1000 sq. in. approx.
Cable connections to instrument	10·1 yd.	equivalent.

Therefore, the total "equivalent" length of cable loop was 3,265·2 yards.

As the scale of the bridge did not go beyond 1,000, the slider was set on 816·3, a quarter of the equivalent length, and the result multiplied by four when balance was obtained.

Calling the ends of the faulty feeder A and B, a test made at A end showed the fault to be 35 yards away. A second test, from end B, gave the fault 701 yards away from B; these two distances total 736 yards, whereas the feeder length was 908 yards, proving an error in calculating the equivalent length of the loop. But it was reasoned that these figures must bear some relation to the true figures, so by proportion 736 : 908 :: 3,265·2 : the true equivalent length = 4,028 yards, and a second series of tests taken with the slider on 1,000 — near enough to ¼ of 4,028 — located the fault 71 yards from end A, which was found to be the correct distance.

All the tests were carried out in the day-time during the ordinary working of the tramway, and each time a car came on the other trolley wire of the section the galvanometer needle was thrown over, but sufficiently reliable readings were obtained by choosing times when no cars were on the section.

CO-OPERATIVE COAL PURCHASING.

By HAROLD C. WRIGHT.

A few months ago there was a discussion at the Institution of Electrical Engineers as to the reasons why electricity was not more generally used, and how electrical energy for power, lighting and heating could be made more popular. Various suggestions were put forward, and the general idea seemed to be that it was necessary to supply everything appertaining to electrical service at lower cost, *i.e.*, "juice," radiators, cooking appliances, &c.

One of the suggestions put forward by that very able and progressive engineer, Mr. H. H. Couzens, was co-operative purchasing of all necessities used in producing electrical energy, amongst which, of course, was coal. In 99 cases out of 100 the coal bill at a power station is one of the largest annual items, and as coal is the first necessity for generating electrical power, it would certainly appear that any means of reducing the coal costs should be welcomed. Without the slightest doubt the way to reduce coal costs is co-operative buying.

The writer of this article has put before the engineers of several of the largest electricity works in London a scheme which interested them very much, but there were many small obstacles in the way which must be got over before the scheme could be properly worked, such as existing contracts falling out at different periods, geographical position which sometimes favoured the purchase of railborne or seaborne coals, &c. The above-mentioned scheme put briefly, is as follows:—

1. Establishment of an efficient central purchasing agency.
2. Purchasing direct from collieries.
3. Having steamers on charter where seaborne coal is required and hiring wagons where railborne coal is required for the sole use of contributors to the agency.
4. Having barges and tugs for sole use of contributors to the agency.
5. Leasing or hiring derricks for discharging steamers or other suitable arrangements.

The benefits to be obtained from the above scheme, taking the items in rotation, are as under:—

1. Middlemen's profit eliminated.
2. Lower prices on account of large amount of coal dealt with.

3. Delays in delivery minimised on account of steamers, barges, tugs, wagons, &c., being used for the benefit of the contributors only.

4. Charter pickings (profits) for the benefit of contributors towards reducing costs.

5. Profits obtained by difference in cost of discharging and allowance made by steamers for benefit of contributors to agency towards reducing cost.

Amongst other items, if large quantities of seaborne coal are used, preference berths are obtainable at most loading ports, thus obviating delay on steamers, and also, as the deliveries are under the control of the agency, facilities for providing stocks in order to allow for contingencies can be well arranged. The recent national coal strike proved the necessity of better arrangements for providing stocks of coal, and as it is practically impossible for a lot of works to secure adequate reserve bunker room, owing to the high value of land, &c., especially those situated in the heart of London, the only remedy is a continuous and regular supply of coal, and special reserve supplies either in barges or coal wagons.

In support of this scheme it is interesting to note that some few years ago many of the big steamship owners were brought together under a co-operative scheme for the supply of bunker coal to their steamers, and the fact that the the Steamship Owners' Coal Association of 9, Fenchurch Avenue, E.C., is not only still in existence, but that it is necessary for them to extend their already large discharging hoists at Purfleet, Essex, goes to show that the scheme is a successful one.

In conclusion, it is the writer's opinion that one of the chief factors preventing the expansion of electrical energy is the lack of co-operation amongst the various municipal authorities and private companies, and petty jealousies that did obtain, but now, fortunately, are gradually disappearing.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Strength of Drawn-Wire Tungsten Lamps.

Referring to your issue of August 9th and the extract given on page 240 of an article by Mr. Bainville in *L'Industrie Electrique* with reference to drawn-wire filaments, I should like to make the following comments :—

Mr. Bainville, among other writers on this subject, appears to consider that because the drawn-wire filament may lose some of its ductility after burning, therefore the drawn-wire lamp becomes as fragile as the pressed filament lamp.

This is an entirely wrong conclusion, as the strength of the drawn-wire lamp does not result from the ductility of the drawn-wire filament alone, but very largely from the method of winding and mounting which the drawn-wire filament permits.

To summarise, the strength of the drawn-wire lamp is due to three features :—

1. The strength of the drawn-wire filament itself.

2. The use of a continuous one-piece wire of uniform cross-section.

3. The method of support of the filament mounted on flexible supports in which there are no rigid joints or welds at the point of support.

The combination of these features causes the drawn-wire filament to be many times stronger than the ordinary pressed filament lamp at any time during its life.

Evidence in support of these merits, and of the greater strength of drawn-wire lamps, has been shown in a number of cases of practical service tests, proving that the drawn-wire filament is suitable in fields of service in which it was not possible to use the pressed filament lamp. Among other notable cases are the following :—The United States Navy tests of drawn-wire lamps on board battleships; the Argentine Navy tests of drawn-wire lamps on board cruisers; tests by the Interborough Rapid Transit Co., of New York City, of drawn-wire lamps on their underground trains.

Besides these service evidences of the superiority of drawn-wire lamps, we have also the evidence of extensive tests conducted over long periods of time by the principal lamp manufacturers using the drawn-wire filament process.

A special filament testing machine has been devised and employed by the Engineering Department of the National Electric Lamp Association, of Cleveland, Ohio, to accurately measure the bending as well as the tensile strength of lamp filaments. As a result of extensive tests made by this machine, the following results were obtained :—

Tensile tests made on both pressed and drawn-wire filaments at various stages of life indicated a strength of from 20,000 to 60,000 lb. per sq. in., which is doubtless far greater than is required of lamp filaments. The drawn-wire showed a greater strength for all sizes.

Specimens of the same lamps tested in bending showed for equal loads 100 per cent. greater deflection for the drawn-wire than for pressed filaments. The breaking load in bending was also greater for the drawn wire.

The greater mechanical strength of the drawn-wire lamp is therefore evident, and is accounted for by the style of filament mounting and the greater strength to withstand shock in the filament itself.

Again, Mr. Bainville is in error in his statement that lamps with drawn-wire filaments show more serious bulb blackening over pressed filaments. This is purely a question of proper manufacturing methods; a drawn-wire lamp improperly exhausted will show blackening to a greater extent than a pressed filament lamp properly exhausted. With proper exhausting methods, however, adapted to each type of filament, there is no excess of blackening for drawn-wire lamps.

To secure correct results on lamps involves much more extensive testing than many writers like Mr. Bainville can afford to undertake. When tests are made on a sufficient number of lamps to give a true average, and the lamps represent the best skill and experience in drawn-wire lamp manufacture, the results will show that drawn-wire lamps have superior strength to others at any time during life.

F. W. Willcox.

London, *August 23rd*, 1912.

The Compulsory Purchase of Tramways.

I read your article on this subject with interest, but I find it very difficult to accept (*c*) paragraph 2, p. 237, that the undertaking is to be valued as a present profit-earning concern, including a proper sum in respect of statutory powers and privileges. The Corporation allows the company to obtain the privileges for a term of years, the concession being of the nature of a lease, only as a rule there is no rent payable for the same. To ask the Corporation to pay for the return of the privileges at the end of the period agreed, is very much as if a man had to compensate a telephone company for moving a telephone wire from his building after they had enjoyed the use of the same for a number of years at a nominal rent! Furthermore, if the payment for the undertaking is to include a sum for its present profit-earning powers, it appears to me that an arbitrator can only allow this after taking careful evidence as to past and probable future profits, and this seems to be prohibited by the Act.

However, no doubt a main object of legislation is to provide points on which lawyers may argue at a suitable remuneration, and the Tramways Act will meet this requirement admirably.

Purchase.

August 26th, 1912.

Trade Discounts.

I have read, with much interest, the article by "Juggins" entitled "To the Trade," and, in commenting on it, would like to endorse all that he says concerning the unbusinesslike systems of discounts adopted by manufacturers.

I should like to emphasise the fact that "Juggins" has in no way exaggerated the wretchedness of the present methods, by quoting the following example :—A few days ago I had occasion to inquire some *net* prices from a certain manu-

facturing firm, and I should like to repeat them as I received them. Article 1, 11d. plus 20 per cent.; article 2, 8d. plus 5 per cent.; article 3, 2d. plus 5 per cent.; article 4, 1s. 10d. plus 20 per cent.; article 5, 1s. 3d. plus 5 per cent.; article 6, 4d. plus 5 per cent.

Further comment on this is superfluous, but there is just one other point I should like to raise. "Juggins" seems to think that 50 per cent. is an exceedingly high discount, but I should like to remind him that, compared with some trade terms, this is relatively low. For example, in the iron and steel trades, discounts often range between 70 and 80 per cent., which I agree with him are decidedly absurd.

In conclusion, I may point out that although the suggestions forwarded by "Juggins" are extremely ingenious, they do not strike one as being a practical way out of the difficulty.

R. C. S. Perry.

London, S.W., *August 23rd*, 1912.

FIRE AT THE LONDON CENTRAL TELEGRAPH OFFICE.

On Saturday last, about 7 p.m., a serious fire occurred on the third floor of the General Post Office West, where the main telegraph gallery is located. The seat of the fire was under the floor close to the large test box for the provincial wires, the most vital part of the vast and complex system of wires and apparatus which constitutes the largest telegraph office in the world. The first intimation of fire was smoke which was observed issuing from beneath the floor of the test room. It was then seen that the fire had obtained a serious hold of the mass of wires leading from the main cables to the test box, and such was the danger that it was considered advisable to order the staff to leave the building.

The fire brigade were soon on the scene and in a comparatively short time were able to master the outbreak. As a precautionary measure, all sources of power, electric, pneumatic and mechanical, were shut off from the telegraph office, and thus, probably for the first time in the history of the telegraphs of the United Kingdom, London was isolated.

The engineering staff was quickly on the scene and commenced the work of restoration at once. Communication by means of alternative routes was quickly effected to some of the large provincial towns. The amount of damage done to the building was comparatively slight, but the communications of the country were completely dislocated owing to the vital point at which the disaster occurred. Fortunately a year or two ago the whole of the Central Telegraph Office was recabled with modern fire-proof cables laid in steel troughing. It is quite probable that had not the modern system of cabling buildings been in use at the Central Telegraph Office the whole building might have been in danger.

Delay in communication with the provinces was experienced on Monday and Tuesday, but normal conditions were practically attained by Wednesday.

Canada.—The Imperial Trade Correspondent at Toronto (Mr. F. W. Field) reports that a consulting engineer, an Englishman, resident at Sault Ste. Marie, Michigan, U.S.A., is desirous of acting as an agent in Canada for British makers of machinery and plant used in connection with hydro-electric development, pulp mills and steel works. Further particulars can be obtained at the Board of Trade Commercial Intelligence Department, London, E.C.

Patent Surrender.—The Comptroller-General of Patents announces, in the *London Gazette*, that Ettore Bellini has offered to surrender Patent No. 11,339, of 1911, for "Improvements in or relating to transmitters and receivers for wireless telegraphic and telephonic apparatus." Anybody desiring to be heard with reference to such surrender must advise the Comptroller by September 21st.

PRACTICAL NOTES ON METER ERRORS.

By S. M. Powell.

With the small margin of profit allowed to central stations by the tariffs now in force, meter errors of 2 per cent. or even 3 per cent. may be of great financial importance as regards the net profit realised. Accuracy in meters is now of greater moment than ever before, and on this account and remembering the great number of new types of meters which have been placed on the market during the past decade, special interest attaches to the comprehensive and highly practical paper read by A. Durand, of the Laboratoire Centrale d'Electricité, before the 1911 Congress of Electricity at Turin. From this lengthy thesis, the following notes are abstracted.

Despite recent innovations, meter errors are still due to the same causes as they were, say, ten years ago, and are still of much the same magnitude. The causes may be grouped as due to (1) Meter itself. (2) Accessory apparatus. (3) Nature of current metered. (4) External agencies. Owing to these causes producing a number of errors, the chief of which are detailed below, certain errors have necessarily to be allowed as "permissible." The meter errors permitted, under various conditions and loads, by the legislatures of various European States are summarised in Table I, p. 331—whence it appears that the English and French requirements involve the highest accuracy.

Reserving a discussion of electrolytic and special-tariff meters to later paragraphs, the magnitudes of the errors due to various causes in different types of meters are as follows:—

Temperature.—Meters should always be tested with their cases closed, for the internal losses have then a very appreciable effect on the temperature of the windings, &c. French law permits a loss of 4 watts per 100 volts in the shunt windings of Thomson meters and 1 volt drop in the field winding, so that, in a 10-ampere, 110-volt meter on full load, the internal losses amount to 15 watts. The temperature rise within the case of a meter of this type, due to the shunt coil alone, may be 10° C., rising to 25° C. (actual temperature then 50-60° C.), when the series circuit is also fully excited. This temperature rise diminishes both the driving and braking torques of the meter and, theoretically, exact compensation between the two effects is possible but, actually, the temperature coefficients of the driving and braking systems are unequal. By using materials of zero temperature coefficient of resistance for the shunt coils and braking disk, the difficulty may be surmounted, but the high electrical resistance of such materials necessitates the use of additional braking magnets or a larger disk to get a sufficient retarding torque. The temperature of the braking disk varies with the position of the latter in the meter case; in spite of agitation due to the moving system, the air is always

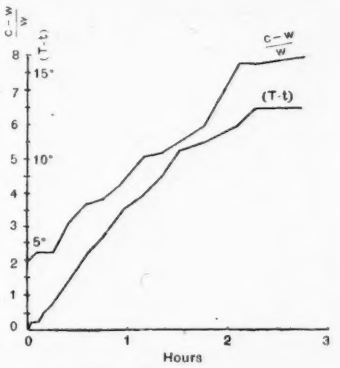

Fig. 1.

warmer near the top of the case. Fig. 1 shows the variations (with time on full load), of the air temperature within the case of a 15-ampere 220-volt watt-hour meter, of a type much used in practice; the resultant error increases as shown (about + 0·4 per cent. per 1° C.). This increase is quite typical of the behaviour of all non-compensated watt-hour motor meters of the Thomson type. Oscillating meters, of the A.E.G. type, have a certain temperature coefficient, but the heating of the shunt circuit is quite low; Aron meters have negligible temperature error unless used with a shunt; the new "O.K." meter has a temperature coefficient of about 1·5 per cent. per 10° C. rise in temperature, but there is a thermal lag between its indications and variations in the power metered. Brakeless ampere-hour meters have no temperature coefficient unless in the shunt; in braked ampere-hour meters, the driving circuit is tapped across a shunt and fixed on the braking disk, so that these two parts rapidly assume the same temperature, and variations of the latter are of little importance. Mercury ampere-hour meters are largely used in this country; if connected to a shunt, they have a certain temperature coefficient. In alternating-current induction meters, the driving and braking torques act on the same disk, variations in the resistance of which are, therefore, of little importance. Owing to variations in the resistance of the shunt circuit, and of devices regulating the starting, a temperature error of 0·1 per cent. per 1° C. is usual

Voltage Variations.—These do not greatly affect meters having no iron cores, providing the shunt circuit has a low temperature coefficient. "Creeping" due to high voltage may be easily avoided, and is little liable to occur when the brushes and commutator have become somewhat worn. In induction meters, ± 10 per cent. voltage variation may cause several per cent. error variations owing to the change in the shunt field, and the braking torque provided by the latter.

Friction.—Brush friction in commutator watt-hour meters may reduce readings by 10 per cent. at $\frac{1}{10}$ load. Owing to the cumulative effects of commutator sparking a short-circuit may occur between bars or an armature conductor may be broken, and, in either case, the meter will show about 10 per cent. error on full load, and will stop on light loads. The use of vibrating brushes facilitates starting, and improves the calibration curve of the meter. In commutator ampere-hour meters, the low armature potential difference reduces sparking to a minimum, but, in braked meters, the increased armature resistance may lead to low readings. In mercury motor-meters amalgamation of the driving disk, and changes in the mercury, gradually vary the total friction. Wear in pivots and jewels is less the lower the weight and speed of the moving system, and friction is of less importance the greater the driving torque. Aluminium braking disks are light, but their high resistance diminishes the resisting torque. It is not sufficient that the ratio (driving torque/rotor weight) be high ; the absolute value of the torque must also be sufficient. Hammering of pivots on jewels, due to heavy external vibration or the use of alternating current, may necessitate rejewelling at intervals of one month or so ; faulty jewels may cause 10 per cent. error at $\frac{1}{10}$ load. Many meters are insufficiently protected by dust-proof and damp-proof cases.

External Magnetic Fields.—A commutator energy-meter with horizontal field, calibrated with the latter in the magnetic meridian, but first aiding and then opposing the earth's field, differs 8-12 per cent. in its $\frac{1}{10}$ load calibration in the two cases, hence it is necessary to standardise such meters with reference to their position relative to the earth's field. When the instruments are installed, the altered effect of the earth's field must be compensated by varying the compounding of the meter. In large meters it is often necessary to take account of the field set up by the cables feeding the meter. In Thomson-type meters the main field is only of the order of 60 gauss, so that special care must be exercised in the disposition of neighbouring current-carrying conductors. Two 300-ampere meters of this type were, in a certain case, mounted 23 cm., axis to axis. When one meter worked at full load, the other was subject to 10 per cent. error at $\frac{1}{10}$ load and 20 per cent. error at $\frac{1}{10}$ load ; by placing a guard plate of sheet-iron between the instruments, the trouble was completely cured. The field magnets of ampere-hour meters may be weakened by external fields, but seldom to a serious extent ; in induction meters, stray fields are of even less importance.

Short-Circuits.—In Thomson watt-hour meters, short-circuits may affect the accuracy of registration by mechanically closing the bobbins together, but are of special danger in that the strong stray field, temporarily induced, may alter the strength of the braking magnets. The seriousness of a "short-circuit" obviously depends upon the resistance of the "short" and of the circuit feeding it and upon the power which can be supplied to the latter. M. Durand presents oscillograph records of short-circuit occurrences in a testing circuit protected by a 20-ampere lead fuse (= double full-load current capacity of the meter), and supplied by various direct current and alternating current sources. According to the available power and the resistance in circuit, the maximum short-circuit current ranged from 100 amperes to about 1,000 amperes (over a period of from 0·7 to 0·04 sec.). After three tests of this nature on a direct-current motor-meter, the latter ran on light load with a registration corresponding to 130 watts, while an induction meter similarly tested afterwards showed 30 per cent. error on half-load. To avoid such brutal tests, the French regulations stipulate a short-circuit current not exceeding 10 times the normal maximum current of the meter, but the worse conditions might evidently arise in practice. The demagnetising effect of short-circuits on the braking magnets may be avoided by placing the latter as far as possible from the field coils and by interposing a magnetic shield. The latter should not be too small, or, by becoming permanently magnetised, it will set up fresh parasitic fields. Errors due to the above cause may amount to 10 or 20 per cent. in meters with small braking magnets, after some time in service ; demagnetisation is a minimum if the magnets are perpendicular to the main stray field. Clock meters are not susceptible to the above source of error. Mechanical displacement of the series bobbins is impossible in induction meters, and the stray field is so small that the error seldom exceeds 1 per cent. after a 10-fold short-circuit. Apart from the possible influence on the magnets of commutator ampere-hour meters, short-circuits damage the brush and commutator surfaces, and may even melt the plates. The high current flowing through the armature during the "short" is due to the elevation of the shunt potential difference, and if the meter is stopped, to the absence of back E.M.F. In mercury motor meters, short-circuits may affect the magnet strength and expel the mercury from its receptacle.

Shunts.—The use of shunts simplifies the measurement of large amounts of energy, and enables the meter to be removed from the influence of parasitic fields. The smaller meters required are easier to build, but it is difficult to maintain the correct ratio between the resistance of the shunt and that of the low resistance series circuit of the meter. The shunt is usually of manganin, whereas the series circuit is of copper, and must be of liberal section if temperature errors are to be avoided. In alternating-current meters, shunts may only be used if their time constant equals that of the meter circuit which they bridge

Creeping.—Vibration, voltage variations, permanent magnetisation of shield plates by short-circuits, orientation of the meter in the earth's field or other external magnetic influences may cause creeping in commutator watt-hour meters. The remedy is to mount magnetic buttons on the brake disk, thus providing a slight "locking" action with the brake magnets. No-load running in Aron meters is due to constructional defects or to variations in the period of one of the pendulums, and is often difficult to detect. Slots or holes in the disk, or magnetic locking buttons thereon, suffice to prevent creeping in induction meters.

Frequency and Wave Form.—Changes in frequency and wave form alter the phase displacement between the shunt current and applied voltage, in commutator meters, by an amount varying with the time constant of the shunt circuit, which should therefore be as low as possible. Aron meters are unaffected by frequency changes, and ± 5 per cent. frequency variation seldom produces more than 1 or 2 per cent. error in induction meters at half load. On the other hand, the presence of different harmonics in the wave form may easily cause 15 per cent. error in induction meters—a fact which largely compensates the advantages which this type possesses over commutator meters in first cost, maintenance and excitation.

Power Factor.—The accuracy of clock and motor-meters depends on the time constant of the shunt circuit and on the power factor of the load supplied. Thomson meters on a 0·4 power factor load show ± 4 per cent. error, according as the current lags or leads. The error may be tolerably corrected by the Frager short-circuiting device or by the insertion of capacity in the shunt circuit, in which case, however, there is danger of harmonic resonance. On single-phase networks where power factors less than 0·5 occur only during the relatively short period in which motors are started, acceptance tests at 0·2 power factor are superfluous. In three-phase meters, low power-factor tests are necessary, and the windings should be tested separately, for there often exists a supplementary phase difference of ± 30°, so that, for a supply power factor of 0·7, one of the meter circuits may have a power factor of 0·25 and the other 0·96. Errors at low power factor have, however, minimum effect on the total energy recorded. The effect of power factor in induction meters is easily compensated.

Transformers.—The use of transformers complicates the question of meter accuracy by introducing supplementary phase displacements (varying from 0·1° to 10°) between the primary and secondary currents. To take account of the characteristics of the transformer, the meter must be tested with the latter connected as for subsequent use. In order that the transformation ratio be constant, the transformer core should be built of thin plates with no joints, worked at an induction not exceeding 2,000-3,000 gauss, the object being to avoid magnetic reluctance and leakage. Ring transformers conform best to these requirements.

Voltage transformers are in permanent service at practically constant induction, hence the only difficulty of construction is in the provision of adequate insulation. Errors due to these transformers may range from —1 per cent. to —5 per cent. (cos ϕ 1·0 to 0·2), and should not exceed 2 per cent. difference between cos ϕ 1·0 and 0·6. Current transformers operate at continually varying induction. At high loads the error should not exceed ± 1 per cent., but below $\frac{1}{10}$ full current no guarantee can be given. In a particular case the error ranged from — 2 per cent. to + 5 per cent. at $\frac{1}{10}$ load for cos ϕ 1·0 to 0·4. Single-phase equipments may be adjusted for an average power factor of 0·8, but no such compensation is permissible in three-phase meters.

Foucault Currents.—These are only of importance in large meters without shunts or transformers. Such meters, if calibrated on direct current, may show 10—20 per cent. error when used in alternating-current circuits. The remedy—which is often neglected—is to laminate the windings and slot all metal parts near the windings.

Construction and Erection.—The chief points requiring attention in the design and construction of meters are : the avoidance of overcrowding of parts, such as leads to mutual electromagnetic influence between parts and obstructs inspection and repair ; the provision of high driving torque ; liberal design of windings to avoid temperature rise and errors ; provision of dust and damp-proof cases. Somewhat higher capital cost need not be grudged, for meter rents equivalent to 20 per cent. on capital outlay are at present common. In erecting meters, the main spindle must be perfectly upright—a point which is of greater importance the heavier the moving system ; reliance cannot always be placed on plumb lines mounted in the meter case. Incorrect connection of both circuits in a D.C. meter will not change the direction of rotation, but, by reversing the orientation of the field, may cause 10 per cent. error on light loads. In three-wire meters, energy is not measured correctly if the shunt is connected across a single side of the circuit. The $\frac{1}{10}$ load error in three-phase meters may vary 3—10 per cent., according to the connection of the phases.

Special Meters.—All the above errors naturally arise in ordinary meters adapted to special purposes by the provision of special switchgear. "Excess" or "peak" meters deserve special mention, as they have already led to several lawsuits. A negative torque, provided mechanically by a spring or electrically by a reverse motor device, prevents the meter from recording till a predetermined limiting demand (up to which a certain contract tariff is in force) is exceeded. The accuracy of the registration depends upon preventing reverse running under the negative torque and on the maintenance of the correct negative torque. One of the best means of securing these aims is to utilise the hysteresis torque exerted on a small mass of nickel rotating between the poles of a magnet. A further point of great importance is to decide whether the permissible error shall be based on the excess demand registered by the meter or upon the total demand as a fraction of the

maximum capacity of the instrument. In the former case we are faced with the uncertain starting load of the meter and all the inaccuracies of a meter when running near its starting point (this condition existing when the total demand little exceeds the critical limit). The author, therefore, recommends that the permissible error should be based on the total demand as a fraction of the maximum meter capacity, and the latter should be either 1·2 or 1·5 times P (where P = critical demand at which meter commences to register); accuracy limits should then be laid down for total demands 1·05 P, 1·10 P, 1·20 P and 1·50 P. Electrolytic meters theoretically measure ampere-hour consumption accurately at all loads. Variations in temperature are liable to cause crystallisation of the electrolyte, and the resistance of the meter being thereby altered, the distribution of current between the meter and the shunt is altered, and serious errors result.

Calibration Curves.—The calibration curve of direct-current meters is practically linear from full to $\frac{1}{10}$ load, whence it is positive or negative, according to the preponderance of friction or compounding; the slope of the linear portion is a function of the internal temperature of the meter. The error in induction meters frequently passes from 3 per cent. slow at full load to 2 per cent. fast at half load; compounding affects the shape of the curve at low loads. Pendulum meters are theoretically accurate, the actual errors depending on friction and the compounding employed to prevent "creeping."

Starting.—Commutator watt-hour meters start at 1 per cent. full load when newly erected and correctly adjusted, and if special vibrating brush-gear is used, the instrument may start at 0·5 per cent. full load—a matter of importance in high-range meters. Ampere-hour meters start at $\frac{1}{100}$ load if braked, and at 0·2 per cent.—0·5 per cent. load if unbraked. Aron meters, without compounding, will start at 0·1 per cent. full load.

Tests in Situ; Accuracy in Measuring Instruments; Official Acceptance Tests.—Tests *in situ* should be more frequent the less the care bestowed on the maintenance of meters; the tendency is for meters to develop slow running and poor starting, and the loss thereby thrown on the central station justifies frequent testing. To allow for the less favourable conditions obtainable in tests of this nature, the permissible error is usually twice as great as that allowed in the corresponding laboratory (acceptance) tests. Meters serving a rapidly varying load may be tested by a portable standard recording meter, or by observations on indicating instruments at intervals of 5 or 10 seconds. Motor meters are found to be very accurate on rapidly varying loads. D.C. wattmeters are very liable to errors caused by stray fields; torsion instruments are only suitable for the measurement of constant loads. Moving-coil instruments are subject to a number of errors, but if frequently calibrated, should be accurate to within 1 per cent. at 0·8 full deflection. Potentiometer measurements in the laboratory may be made to within 0·2 per cent. accuracy under practical conditions; A.C. wattmeters are affected by the power factor of the circuit metered and by supplementary phase displacements, but 0·5 per cent. accuracy at 0·8 full load is obtainable in good types of instrument; if the sensibility is varied by coils in parallel, great care must be taken with the connections. In a 1-minute test, 0·2 second error in releasing and stopping the chronometer may produce 0·3 per cent. error in the result. The methods of measurement and the accuracy of the meters themselves do not justify laboratory certificates being given to 0·1-0·01 per cent. accuracy, as is often the case. The Laboratoire Centrale d'Electricité gives certificates to ± 0·5 per cent. accuracy, and denies the significance of any higher accuracy.

Among the meters tested for "acceptance" at the Laboratoire Centrale d'Electricité, 14·3 per cent. of the commutator watt-hour meters, 40·0 per cent. of the commutator ampere-hour meters, and 47·0 per cent. of the commutator induction meters, at once pass the statutory (French) tests. These figures, referring to modern types of meters, show that the French error limits (which are very similar to our own, see Table I), cannot yet reasonably be narrowed.

STEAM TURBINE RUNNING.*

Large turbines are built essentially on the principle of high efficiency, and their design and mechanical construction is accordingly more elaborate and complicated than for small ones.

The present remarks apply to this class of turbines only, as requiring naturally more careful attendance and being subject to more disturbances.

Clearance.—With regard to this point, impulse and reaction turbines show somewhat different requirements. Whereas the radial clearance in impulse turbines is practically unlimited and the axial distance can be made 0·1 to 0·2 in. and more without appreciable loss in efficiency, the reaction turbine demands reduced the radial clearances to the lowest practical amount. The blades need not run close together, but, to prevent excessive leakage over their tops, the distance between the ends of the moving blades and the casing and between the ends of the fixed blades and the rotor must be kept down to 0·025 to 0·125 in., according to the size of the machine and the length of the blades.

The axial adjustment is controlled by the thrust bearing, which can be moved in either direction by bolts acting on the casing. This adjustment being made with minute care in the erecting shop, it is advisable for the operating engineer to leave it undisturbed, except in case of necessity. After the machine has been taken apart and put together again a new adjustment must be made. This will be done with the machine slowly running. The thrust bearing is moved one way until a slight contact is noticed (the noise will be more easily detected by a proper piece of wood applied to the casing and the ear), then brought back the desired amount of clearance.

Gland Packings.—A few types of turbines, especially the original Parsons turbine, apply the principle of the labyrinth to the stuffing-boxes. This has the advantage that friction losses are absolutely avoided, at the cost, it is true, of a small steam loss.

The leading firms in this country have adopted devices of another kind; the General Electric Co. uses a carbon packing, the Westinghouse and Allis-Chalmers companies a water-gland packing. With the former the engineer will have to remember that the carbon rings should have a loose fit on the cold shaft; as carbon does not expand, but contracts through heat, the expansion of the shaft would open the segments of an exactly fitting ring when warming up, and leakage would occur. The carbon rings do not need lubricating, but are likely to break and wear out. In the long run they have been seen to cut regular grooves in the shaft; the latter, therefore, often has an interchangeable bushing.

The water-gland packing ensures a perfect closing of the turbine, but the runner, forming a little centrifugal pump which forces the water in a circumferential sealing space, absorbs a certain amount of power. Besides, if the water is not perfectly clean, it will deposit scale in the glands which has to be removed, sometimes frequently. Finally the water which passes into the turbine will evaporate there, and may cause the formation of a considerable layer of scale on the blades, with a very detrimental effect on the steam consumption. The water supply must be carefully regulated to keep the leaking quantity as small as possible. To avoid evaporation in the glands the temperature should be the lowest obtainable. The water should come to the glands with a few pounds pressure.

Bearings.—The next important parts to be considered are the bearings. They constitute with a few gears (worm-gear for governor shaft, tachometer drive, oil-pump gear) the only parts of the turbine where actual metallic friction takes place. As no other acting forces are transmitted by the shaft besides its own weight, the wear of the babbitt shells will be extremely little.

* Abstract of prize article by Paul Hoffmann, which appeared in *Power* (U.S.A.).

TABLE I.—Comparison of Statutory Limits on Meter Errors in Various Countries.

—	Load. ± % error at various loads. 1/1	1/2	1/10	1/20	Frequency. % frequency change (±)	% error (±)	Power factor. ± % error at half-load power factor 0·5.	Voltage variation. Effect of ± 5 % variation.	Short-circuit. % error due to $Ct. = 10 \times C_{m \cdot c.}$	Creeping. Power registration permitted.	Starting. Maximum power to start.
England (A)	2	2	2	—	10	2	—	—	—	Nil; even with	—
(B)	3	3	3	—	10	3	—	—	—	10 % excess V.	—
Germany ...	3·3	3·6	6	9	—	—	7·1	—	—	0·25 % of P.	—
Austria ...	4	4	4	—	2	4	—	Nil	—	0·02 % of P.	1·5 % P above 3 a. 2 % P, 3 a. and below.
Spain ...	—	4	—	—	—	—	—	—	—	—	—
France (C)	3	3	—	5	5	N ± 1	3	—	Q ± 1	Nil	1·0 % of P.
(D)	3	3	—	2 w. at 20-w. load.	5	N ± 1	3	—	Q ± 1	Nil	2·0 % of P.

D.C. or A.C.; normal voltage and frequency; p.f. unity.
A = above 3 amperes; B = 3 amperes and below; C = above 500 watts; D = 500 watts and below; N = error at normal frequency; P = normal maximum meter power; Q = error at half load before "short."

Further French Regulations:—

Voltage drop in series circuits ... ... Ampere-hour meters, 1·5 volts
Watt-hour meters, 1·0 volt above 500 watts; 1·5 volts 500 watts and below

Watts dissipated in shunt circuits ... ... Direct current, 4 watts/100 volts
Alternating current, 1·5 watts/100 volts

Meters with transformers ... ... Error at 1/20 full load not to exceed ± 7 per cent.

The bearings are flooded with oil under pressure; this enters between the babbitt and spindle and forms a continuous film, acting like an elastic cushion. The oil pressure is furnished either by a special oil pump driven from the turbine shaft, or by gravity. A disadvantage of the former system is the necessity for an auxiliary steam or hand-driven oil pump, as the main pump does not deliver enough pressure right from the start.

For gear and helicoidal pumps the decrease of delivery due to the wear must be considered.

In a gravity system the oil is supplied to the bearings from an elevated tank to which it is returned after use by a separate oil pump, and the stored quantity of oil can be much larger.

Starting a Turbine.—A turbine to be started for the first time, or after a long stop, should be cleaned and inspected with special care. This applies chiefly to the bearings, the oil pipes and oil reservoirs, where the least particle of dirt or grit is harmful. The steamways and piping should be gone over, too, very carefully. The steam pipe should be blown out from the boilers, the last connection to the turbine being removed. All kinds of dirt, chips of gaskets, red lead, &c., will appear on this occasion, which would have obstructed the steam passages (guide vanes) if not removed.

The oil should be strained through cloths when poured into the machine. A sufficient quantity must be provided. The air should be driven out of the oil piping by operating the auxiliary oil pump. The bearings will have to be generously oiled before starting.

Revolving the shaft by hand will show if there is any hindrance to its free rotation. This preliminary work being done, the warming up of the turbine can begin. To begin with, open the throttle-valve just a little, and increase gradually; open the drains, and leave them open until the turbine is nearly at full speed.

Reaction turbines require more careful treatment on account of the smaller clearances and the large mass of the rotor. One-half to two hours is not too much for these machines. For impulse turbines, half this time may be sufficient. In an emergency, when a turbine must take up the load of a broken-down unit as quickly as possible, the time for warming up may be considerably shortened. A practice followed in Germany, is to start the turbine running slowly from the beginning, the warming up going on while the speed is being gradually increased.

During the time the turbine is warming up, the auxiliary machinery can be got under way. Where the turbine has water glands, the vacuum can only be created and the air-pump started after the turbine is at a certain speed, because the glands do not act before a certain centrifugal force is developed, and until then a great quantity of air can pass through the stuffing boxes into the condenser. If a central condenser is used, such a turbine has to be put up to speed with the valve between the turbine and the condenser closed, exhausting in the meantime to the atmosphere.

A turbine should always be speeded up slowly. If accelerated too quickly, vibration may start quite unexpectedly and continue a good while after starting. The passage of the critical speed, if a flexible shaft is used, is an exception to the above rule; it has to be done promptly, as, in that range of revolution, vibrations have a particular tendency to develop and to increase dangerously.

After normal speed is reached, with a good vacuum established, the load should be put on by steps, to avoid a sudden inrush of steam into the turbine, which will very likely be accompanied by a water slug.

If the turbine is to run in parallel with other units, the governor can be adjusted for variable speed while the turbine is in operation, thereby facilitating the synchronising of alternators.

It is helpful to always follow the same routine of duties when a turbine is started or stopped. For instance, the operation of the auxiliary oil pump has to be combined with the observation of the pressure gauge, which indicates the moment when the main pump begins to work. The moment for opening the water supply valve to the cooling coil must be delayed until the oil is warmed up a little and becomes more fluid, &c.

Operation.—Although the turbine takes care of itself automatically, so to speak, and intelligently, it must receive due attention.

At regular intervals, the engineer in charge of a watch should go over his machine, observe the pressure and vacuum gauges, the tachometer, measure the temperatures of the bearings and of the oil, and inspect the water supply to the cooling coil, the packing glands or the water-cooled bearings, if there are any.

An equal share of supervision should be given to the condensing plant, and especially should any drop of the vacuum or irregular behaviour of the vacuum gauge incite a thorough investigation.

The sources of trouble in a turbine can often be located in the oiling system. It should be seen to that the cooling coil remains effective, that deposits of mud through the water, or of gum or vaseline-like substances on the side of the oil, are removed. The water used for cooling and other purposes should be clean; if necessary it should be filtered or treated against scale-forming elements.

Only pure mineral oil of not too high viscosity—a light-bodied oil—is to be used.

The temperature of the oil at the outlet of the bearings should be about 140° F.; not much higher, for fear of heating, nor much lower, for the sake of fluidity.

If a bearing gets hot it can be easily smelled and seen by the dense white fumes of the burning oil. There is generally some radical cause for a hot bearing, which should be immediately removed—a tight cap, grit or foreign substances in the oil, insufficient oiling. The maximum oil supply should be tried, and if this gives no relief the turbine should be stopped at once rather than have the bearing burn out. It is to be remembered that quick action is necessary; the high circumferential speed of the journal does not allow much chance for reflection or hesitation, and there is no time for nursing the bearing back into good condition.

Any other, and especially internal diseases of a turbine, are indicated by one sure symptom—vibrating of the machine.

A considerable lack of balance causes vibration at any speed, and is the principal, if not the only, cause of all vibration. It has been known to result from the irregular expansion of the rotor due to quick warming up, but every sudden change (especially rise) in temperature may equally provoke distortion of the wheels or warping of the spindle. When superheated steam is dealt with this point should always be observed. A change from condensing operation to atmospheric exhaust calls for attention for this same reason, and should not be rushed.

On the other hand, water drawn into the turbine with the steam will act as a very effective unbalancing mass and mostly with very bad consequences; and very obviously a blade flying off will create an overweight on the opposite side of the rotor without regard to the other effects.

Vibration due to any one of these causes always has the same effect; it brings the revolving and stationary parts of the labyrinths into contact, with friction, heat and deformation as results, and the least that will happen will be the destruction of the small clearances and increased leakage and steam consumption.

It is, therefore, always advisable, when a turbine begins to vibrate for some unknown reason, to moderate the speed at once, and to give the rotor an opportunity to get into good shape again. If the vibration persists after a new start, and goes on increasing, the trouble should be looked after.

If at all possible, turbines should be supplied with superheated steam. In the first place the probability of getting water into the turbine becomes much smaller, and further, superheated steam causes far less erosion of the blades than wet steam.

In turbine plants large dimensioned condensers are usually provided. With either surface, barometric or jet condensers, a vacuum of 27 in. to 28 in. can easily be maintained and should be. The water temperature is here the principal factor, and other facts might have to be considered, which would require a detailed treatment. Running the condensing apparatus properly is a task which takes generally more of the engineer's time and attention than the turbine itself. Before leaving the subject, the importance of frequently inspecting relief valves may be mentioned.

A last rule for the benefit of economy: reduce the amount of idle running of a turbine working in parallel with other units. Care should always be taken to handle the load so that no turbine runs for any length of time at much less than half load.

Shutting Down.—When an independent turbo-generator is to be shut down, the throttle valve can be closed before the load is taken off; the latter acts as a brake and brings the turbine quickly to rest.

A turbo-generator running in parallel must have the load thrown off first and then the throttle quickly closed. Then the condenser is stopped and the steam drain opened to break the vacuum. Finally the water supply is shut off, but the oiling should be continued until the turbine is completely stopped.

Inspection.—At regular intervals, and at least once a year, the turbine should thoroughly inspected and all details gone over. This applies to the interior of the turbine especially. Having lifted the cover, the clearances between rotary and fixed parts should be examined and readjusted. The rotor had better be removed and the blades minutely examined for erosion, scale, cracks, &c. The guide blades should undergo a thorough inspection, too, and be cleared of obstructing matter.

The whole oiling system, chiefly, wants complete cleaning; the oil coils should be scraped outside and blown out with steam. Paraffin oil removes the gummy oxidised deposit, mentioned before as a result of bad oil. The oil strainer should be cleaned and an entirely new supply of oil put in. This is usually only necessary once a year; in the meantime the oil can be filtered and some new oil added to compensate for losses from leakage and evaporation. Bearings and stuffing-boxes will probably want some overhauling, too, and the governor and valves, the gears and oil pump should be gone over thoroughly. Great care must be taken in handling the rotor that no blades are injured; much trouble may arise from small damage.

The inspection will have to extend to the condensing plant. Air leaks may be looked for, and water leaks in surface condensers. Pumps, pipe lines, especially foot valves and strainers, must be cleaned and put in good shape.

The indicator diagram, which affords an excellent guide to the reciprocating engineer, is of no use with a turbine. Steam measurements, compared with electrical output, are here the thing required.

The average engineer cannot be expected to proceed with the care used in acceptance tests, and refined measuring apparatus will generally not be at his disposal, but a scale for weighing the condensed steam and a few thermometers will give sufficient data for fairly approximate results.

Manufacturing in Mexico.—H.M. Legation at Mexico City report that a contract has been signed between the Ministerio de Fomento and Senor A. Elozua for the establishment of factories in Mexico for the manufacture of all kinds of rubber goods, including motor and carriage tires, waterproof cloth, insulated wire, &c. At least £25,000 must be spent on the first factory. All materials and plant necessary for the establishment of the industry, as well as electric lighting equipment and fire extinguishing appliances, may be imported duty free.—*Board of Trade Journal.*

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The "Terroid" System of Electric Wiring.

A new wiring system has just been introduced, under the above title, by the Western Electric Co., Ltd., of North Woolwich, with a view to lowering the cost of an installation without detriment to its efficiency or durability. The leading features of the system are shown in the accompanying figures. The wire (fig. 1) consists of a principal insulated conductor of standard pattern, to the outside of which is attached a return conductor, having a

Fig. 1.—"Terroid" Conductor.

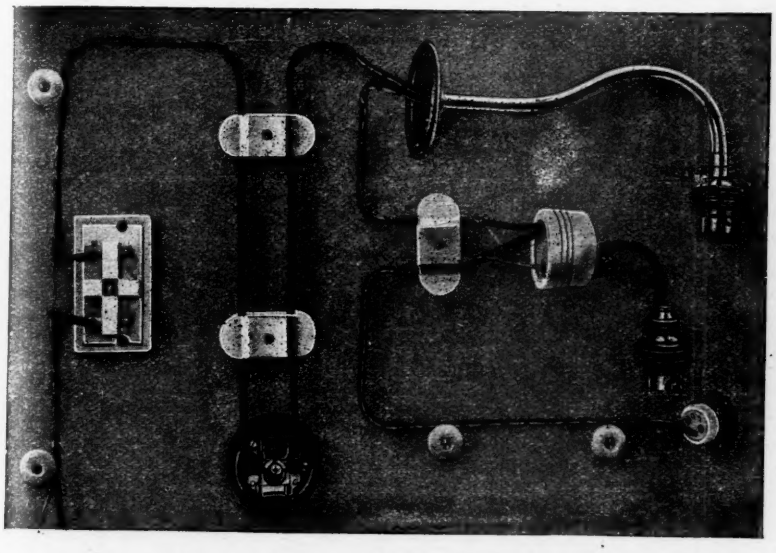

Fig. 2.—Method of using "Terroid" Wire for Open Wiring.

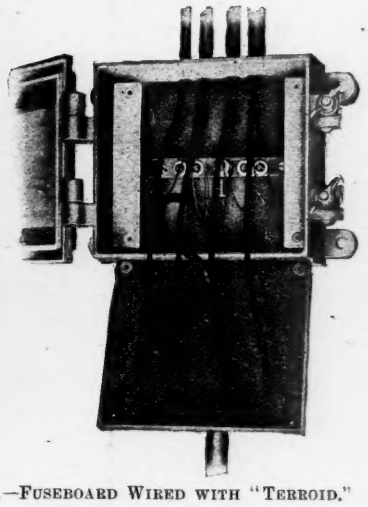

Fig. 3.—Fuseboard Wired with "Terroid."

lower insulation, or none at all, in such a way that the two can be readily separated for local distribution. The cost of the combined conductor is much less than that of two insulated wires of similar carrying capacity. The wire can readily be drawn into conduit, being smaller than a pair of insulated wires; no special tools are required, and the conductor can be used with casing or for open wiring. The system has been adopted for use by one of the Government departments, and it is claimed that it conforms in every particular with the I.E.E. Wiring Rules, the Home Office and B. of T. Regulations, &c.

G.E.C. Coffee Percolator.

A recent addition to the General Electric Co.'s electric heating and cooking appliances is a newly designed coffee percolator with a self-contained heater. It is neatly constructed of copper, heavily nickel-plated, with a handsome black handle. When this percolator is filled with cold water, spraying will begin in less than three minutes after the current is turned on. A small quantity of the water is rapidly brought to the boil, and then this water is automatically forced through a tube to the top of the vessel, where it sprays down and over the coffee grounds. The latter are placed in a separate chamber in the upper part of the pot and thus are not kept soaking in the liquid, with the result that coffee made in this way is as light and clear as wine and possesses the pure and delicious flavour of the coffee berry. Incidentally, less coffee is needed and cheaper berries may be employed, yet the coffee will be better; the quality of the coffee is uniformly excellent and does not vary day by day.

Fig. 4.—G.E.C. Coffee Percolator.

Fuller's Patent Block Accumulators.

An interesting type of storage cell has been developed by Messrs. John C. Fuller & Son, Ltd., of Woodland Works, Wick Lane, Old Ford Road, E., and is now being marketed under the above title. Defying the accepted view that electrolytic action is confined to a shallow layer of the active material, the makers have constructed electrodes in which large masses or blocks of paste are carried on small grids, the weight of the paste far exceeding that of the grids; these blocks are either triangular or segmental in section, as shown in the accompanying illustration, fig. 5, and are formed right through. The result, we are informed, is that the electrodes are immune from damage due to vibration and short circuiting, are free from sulphating, and retain their charge for a year or more without dropping below two volts per cell. There are no "plates," with their liability to buckling; two segmental electrodes, wrapped with glass wool and perforated celluloid separators, form a cell similar to a round primary dry cell, about 6 in. high × 3 in. in diameter, or four triangular electrodes are coupled together so as to form a cell square in section, with either a celluloid or a glass container. Larger numbers of electrodes up to eight are used to build up cells of greater capacity; fig. 5 shows a round cell (without container) consisting of six electrodes, smaller round and square cells, a segmental grid and complete segmental positive electrode, and a triangular negative electrode. Two cells mounted as usual in a celluloid box form a four-volt ignition accumulator, which is made in various sizes. The cells have already been extensively adopted in place of dry cells and plate accumulators for telegraphy, telephony, train-lighting, car-lighting, ignition, &c., and we understand that they have proved admirably adapted for all these purposes. On account of the construction of the electrodes, their internal resistance is not so low as that of plate cells, but this has

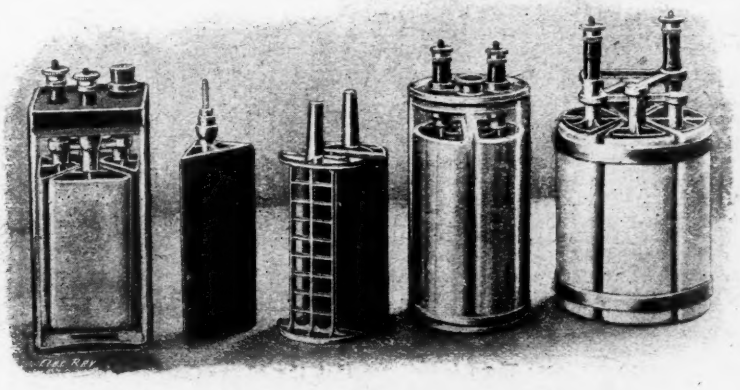

Fig. 5.—Fuller Block Accumulators and Parts.

little effect on their efficiency at low discharge rates, and their ampere-hour capacity, it is claimed, is considerably greater per pound of cell than that of plate cells at low rates. The block cells recover their voltage instantly after a short-circuit, and can be short-circuited for an hour without injury. Owing to their ability to hold a charge almost indefinitely and their consequent freedom from sulphating, they are particularly suitable for use where frequent charging would be inconvenient or impossible; unlike dry cells, which are useless when discharged, the block cells can be

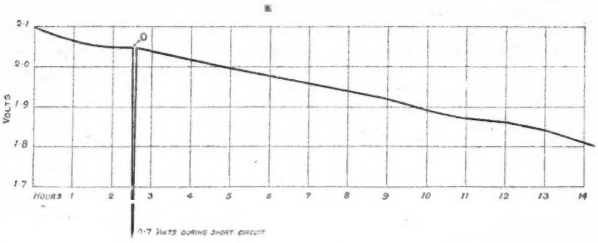

Fig. 6.—Test of 280-amp.-hour Train-Lighting Cell.

used for similar purposes for many months, and when run down can be sent to a charging station for restoration to their full initial value. The grid being buried in the block, can be made of antimonial lead without fear of troubles due to growth, and the active material cannot fall out of place. Fig. 6 shows the result of a test on a 280-amp.-hour train-lighting cell discharging at 20 amperes, made by Mr. C. E. Wright, electrical engineer to the North-Western Railway of India; at O the cell was short-circuited for 1½ minutes, but immediately recovered.

LEGAL.

Attorney-General *v.* London Electric Railway Co.

The motion by the Attorney-General at the relation of the Gordon Hotels by which an interim injunction was sought to restrain pumping by the defendant company in alleged breach of their Act of Parliament, and in a manner likely to cause damage to property in the neighbourhood of Northumberland Avenue, was again before Mr. Justice Bankes sitting as vacation judge, on Thursday, August 22nd. Mr. Felix Cassel, K.C., and the Hon. B. B. Ponsonby were counsel for the plaintiffs, and the defendants were represented by Mr. Bramwell Davis, K.C., and Mr. Mossop.

Mr. Bramwell Davis said that affidavits filed by the plaintiffs had been placed in his hands that morning, and as they raised new matter he must ask for a further adjournment in order to answer them.

Mr. Cassel said they were affidavits in reply.

Mr. Justice Bankes said that he had read all the affidavits that had been supplied to him, and it seemed the questions between the parties were entirely defined. First of all, there was a question whether what the defendants were doing was an infringement of their Act of Parliament. Then, supposing it was, ought he to interfere by way of interlocutory injunction if he was satisfied upon the evidence that there was no immediate danger to the relators' hotel. It must be borne in mind that the Hotel Co. had raised no objection to the pumping on the assumption that it was not going to do any damage, and now supposing that it did, ought he to interfere by interlocutory injunction?

Mr. Cassel submitted that that was not the position, but even if it was he should cite authorities to show that laches by a layman could not interfere with the rights of the Attorney-General. He had only allowed the laches on the assurance that they were going to do them no damage—that was to say, the relators.

Mr. Justice Bankes said he was only speaking of the relators.

Mr. Cassel: They were justified in what they did, because there was evidence that at the time there was no real danger.

Mr. Justice Bankes said the difficulty he felt was this: Supposing the plaintiffs were to satisfy him that danger was now anticipated, could he interfere if the effect of an injunction would be to flood the defendants' works?

Mr. Cassel: Our engineer says that really is nonsense. The only person that says there is danger of flooding is the engineer of the works himself. Further, the defendants had affidavits by six very eminent engineers, and none of them supported that suggestion.

Mr. Bramwell Davis: There is evidence that the effect of stopping this pumping might be to flood the Victoria Embankment.

Mr. Cassel: I submit that that is a perfectly ridiculous suggestion. There was a number of methods by which that might be easily prevented.

Mr. Justice Bankes: The affidavit of the defendants' engineer seems to say, "If I cease pumping I shall flood the whole place."

Mr. Bramwell Davis said he must answer the later evidence. It said that the defendants had six pumps working, and that was not so.

Mr. Cassel did not care if they had only four. It was quite sufficient for him that they took away 100 gallons a minute—50,000 gallons a day.

Mr. Justice Bankes said that because there had been an infringement of the Act of Parliament it did not compel him to grant an interlocutory injunction, supposing there was no danger. He was very strongly impressed by the suggestion that to stop the pumping at this station would flood all the other works. The evidence did not say that the work could be done in any other way; but supposing he was satisfied that it could be done in some other way, of course there would have to be time allowed the defendants to enable them to adopt some other way. They did not say in their affidavits how long it would be going on, and he did not see on the evidence as it stood why he should not stop it.

Mr. Bramwell Davis said the cases would show that his Lordship had a discretion in the matter.

His Lordship: When there is an Act of Parliament that says you shall not do it?

Mr. Bramwell Davis: Yes.

His Lordship: If I am satisfied that the work could be done in some other way, even though the work might be more expensive? Are you prepared to say that it cannot be done in some other way?

Mr. Bramwell Davis: It could only be done in some impracticable way, and at enormous expense.

His Lordship said he had not any material before him upon which he could exercise his discretion.

Mr. Justice Bankes said the mere fact that the defendants were not causing immediate injury to the hotel would not lead him to exercise his discretion in their favour is he was satisfied that they could do the work in some other way. If they could, and the way they were now doing it was an infringement of the Act of Parliament, he should grant an injunction.

Mr. Bramwell Davis said there was an overwhelming body of evidence to which he would draw his Lordship's attention, that there would be no danger anywhere by their workings.

His Lordship: But there is a clause in the Act of Parliament which says you shall not pump.

Mr. Bramwell Davis said that was a model clause and it had been inserted in all these underground railway Acts now since 1908, and yet they always pumped.

His Lordship suggested that the matter might stand over, for if he granted an injunction he should suspend its operation. Why should the motion not stand over to be dealt with by Mr. Justice Neville on the first motion day in next sittings?

Mr. Cassel pressed for some immediate relief, for although since the defendants' assurance the water had not up to then fallen below its normal level. He understood that at the plaintiffs' bore hole there were now some signs of shrinkage.

His Lordship said it seemed to him that the question was whether there was any other practicable way of doing this work. It was not on any of the affidavits so far as he could find. It was a most important point, and, therefore, Mr. Bramwell Davis must have time to file further evidence.

Mr. Cassel said if his Lordship considered that was the point, and desired further evidence, he could not resist a further adjournment, but asked that it should be only for a week. Whatever time was given the defendants to adopt a new method of working, that time would be so much longer if an injunction was not granted until after the vacation. They had now reduced their pumping to 30 gallons a minute, and if an undertaking were given that that quantity should not be exceeded, he was willing that the motion should stand over the vacation.

Mr. Bramwell Davis said he could not give that undertaking, but was willing to say that they would continue pumping as at present, except in a case of great emergency.

Mr. Cassel said he could not accept that assurance, as he was instructed that the water in their bore hole had already gone down.

Mr. Bramwell Davis said he would undertake not to pump more than 60 gallons a minute, and after some further discussion, it was agreed that the motion should stand over until the second motion day in next sittings, the defendants undertaking to pump as little as possible, and not to exceed 60 gallons a minute except in case of grave emergency. The defendants were to file their evidence by September 14th, and the plaintiffs to complete theirs by the end of the vacation. Liberty was given to either party to apply in the vacation if necessary.

Mr. Bramwell Davis asked for leave to inspect the plaintiffs' borehole.

Mr. Cassel had no objection, but asked that the plaintiffs should be allowed to inspect the defendants' pumping.

Mr. Bramwell Davis thought that was quite reasonable.

Mr. Justice Bankes: Then there will be liberty to the plaintiffs to inspect the defendants' works and pumping, by an engineer, in the presence of some representative of the defendants, and there will be a like liberty to the defendants to inspect the relators' trial hole and take levels. There would also be liberty to the relators to inspect the defendants' daily pumping returns.

Fencing Electrical Machinery.

At Glasgow Sheriff Court last week the Scottish Tube Co., Ltd., were charged with having failed to securely fence the pinion wheels of an electric motor which drives a travelling crane in their works in Swanston Street, at which, on June 10th, a workman, named William Duffy, was accidentally injured.

In tendering a plea of guilty, it was stated by a law agent that the accident was of a trifling nature. Duffy had been oiling some parts of the machinery, and, bending over, his coat caught between

the pinion wheels. He sustained a few bruises and a cut on the head, and was only off work a few days. He did not claim compensation. The machinery was pretty well guarded, and it had not occurred to anyone inside the works that the pinions should be fenced.

By the SHERIFF: No request had been made that they should be fenced.

The INSPECTOR of Factories and Workshops said the obligation to fence machinery was absolutely clear; and the Court would understand the great necessity for such precautionary measures when he stated that no fewer than 15,000 cases of neglect occurred in the Glasgow district last year.

The Sheriff imposed a £5 penalty, with expenses.

NOTES ON IMPREGNATION OF WOODEN POLES.

BY W. MANKTELOW.

CREOSOTING is undoubtedly the best preservative treatment yet devised for wood, but a deep penetration of the impregnant is less readily obtained with the tar product than with mineral substances. To facilitate thorough butt saturation, various methods of perforation of the wood have been tried, and the results of a specially elaborate investigation by Messrs. Haltenburg and Berdenick (of the Hungarian State Impregnating Department at Puspokladany) were recently announced in a paper before the Société Electrotechnique de Dresden.

Radial holes, about 2 mm. diameter and 4 cm. deep, are formed in the pole by high-speed nail-formed spikes, which displace but do not remove the wood. The loss of strength in poles perforated by this process is negligible. On comparing the mechanical strength after treatment of poles in which radial perforations were made by displacement with the strength of a similar batch of poles in which 3 mm. holes were drilled and plugged after impregnation, it was found that the former were weakened to no appreciable extent, whereas the latter lost 25 to 40 per cent. in strength.

Several hundreds of poles of various timbers were tested, and the effect of the distribution of the radial perforations was especially examined. By placing the perforations on a spiral of about 50 mm. pitch and at a distance, hole to hole, of about 40 mm., each hole being about 10 mm. to the right or left of the hole in the spiral beneath it, excellent impregnation is obtainable even in such timbers as pine and fir. Only that portion of the butt which is below and immediately above the ground level is perforated, and a special machine has been designed to enable the rapid and accurate treatment of poles.

From an analysis of statistics extending over the past 50 years, M. Cristiani concludes that the average life of poles is as follows:—

Impregnated by Boucherie $CuSO_4$ process	...	11·7 years
" " zinc chloride "	...	11·9 "
" " Kyan $HgCl_2$ "	...	13·7 "
" " early creosote processes	...	20·6 "

American authorities estimate the life of creosoted timbers of various kinds to range from 20-30 years (being from 2·0 to 2·5 times the life of the timber untreated). German returns—probably the best in the world—show, during a period of 52 years, an average life of 21 years for creosoted Baltic fir. There is no doubt that several of the recent creosoting processes will show even better results, while involving less initial outlay, and avoiding a considerable amount of the unpleasantness hitherto inseparable from the handling of creosoted timber, by leaving a "cleaner" pole, *i.e.*, one with less surplus creosote in the surface layers.

Poles are almost invariably creosoted before use in this country, but in America only about 20 per cent. of poles are treated (though the proportion is steadily increasing), owing to the greater relative cost of creosoting in that country. An approximate formula for estimating the annual charge to be debited to poles is—

$$a = \frac{200 \cdot p}{200\, n + (n\,(n-1))\, r},$$

where, a = annual charge; p = investment (including cost of treatment, if any); n = years life; r = interest (say, 6 per cent).

As illustrative of the unfavourable position of creosoting in the States, it may be noted that the Virginia Railway and Power Co. recently installed 900 untreated chestnut poles and 300 creosoted loblolly poles (the loblolly pine contains a very large percentage of sap, and hence will absorb a large percentage of creosote*). The cost of the chestnut poles ranged from 13s. to 14s. 6d. each, and that of the treated loblolly poles was 28s. 9d. each (35-ft. poles, 8 in. top diameter). The life of the chestnut poles is expected to be 13 years, so that the longer life of the loblolly is balanced by its greater cost. In many cases, consumers pay for a pole of 36-in. ground circumference rather than for a creosoted pole 28 in. in ground circumference (thus allowing for 1·25 in. decrease in ground diameter by rotting in the untreated pole). Such wastage of large timber is a serious matter at the present day, when the area of forests (let alone timber ready for felling), is decreasing at such an alarming rate.

Intermittent reports come to hand of methods of timber preservation based on the electrolytic replacement of sap by saline solutions. These systems are fairly rapid in operation, and the electrolytic action causes a certain amount of chemical change to take place in the cells of the timber during treatment, which would otherwise occur during its use. This tendency to a more durable preservation is quite offset by the readiness with which most salts are leached out by rain. In the Nodon-Bretonneau process a compound electrolyte is used, in which magnesium sulphate effects seasoning, zinc sulphate acts as preservative, and ammonium sulphate and boric acid exercise a fireproofing and antiseptic action. The seasoning and preservative action occupies 7 to 14 hours, and the fireproofing process from 14 to 24 hours.

The electrical seasoning of wood, apart from any preservative treatment, has recently been successfully demonstrated in Melbourne. Current at 2,000 volts was applied to two large green logs, and the sap boiled out at such a rate that the logs lost 400 lb. in weight during three hours' treatment. It is estimated that a growing tree could be seasoned within six months by this process, but no information is yet available concerning the loss of strength, which it seems likely would be considerable.

COMPANY AND CONSUMER.

[FROM A LEGAL CONTRIBUTOR.]

QUESTIONS frequently arise which involve a discussion of the legal relations between electric supply companies and consumers. While much depends upon the terms of the contract which is entered into when the supply is first taken on, there are certain general principles which can be laid down upon a consideration of the Electric Lighting Acts, 1882 and 1888, and, more particularly, the schedule to the Electric Lighting Act, 1899, which contains a form of provisional order which is now applicable to the supply of electricity in nearly every district.

It is proposed in the present article to discuss some of the points which are continually arising:—

1. Generally.
2. Epitome of rules as to the supply of electricity.
3. Legal liability to grant a supply.
4. Supply within a certain area.
5. Regulations for ensuring a proper and sufficient supply of electricity.
6. Liability to pay a minimum.
7. Whether consumer bound to take continuous supply.
8. Agreement not to take supply from elsewhere.

* It is fairly easy to get 22-24 lb. of creosote per cb. ft. in loblolly, whereas 10-15 lb. per cb. ft. is considered a very high allowance in pine.

9. Methods of ascertaining amount of energy supplied.
10. Agreements between company and consumer.
11. Who is liable for electricity supplied?
12. Time for proceedings.
13. Notice to disconnect.
14. Alteration in the price of electricity.
15. Remedies of the consumer for failure of supply.
16. "Power companies" and consumers.

1. *Generally.*—Upon making an inquiry into the Electric Lighting Acts, 1882 to 1909, with a view to finding out the exact legal relations which exist between company and consumer, the first difficulty with which the investigator is confronted arises from what is known as "legislation by reference." For some obscure reason, many enactments which deal with the recovery of charges by the company, or the enforcement of their strict rights by consumers, are to be found in older statutes relating to gas and water supply. The result is that, in order to ascertain their exact legal position, those who are interested in the supply of electricity must refer to Acts which relate to gas and water, and to cases decided upon the construction of such Acts. In the following summary of the law we are, therefore, compelled to draw our conclusions from some parts of the Electric Lighting Acts, as illustrated and explained by previous legislation, and the cases which have arisen thereunder.

Just as gas and water are supplied compulsorily under and subject to the terms of an Act of Parliament, so every consumer within the district of an electric lighting company is entitled to demand and obtain supply from any company or local authority who have statutory powers to give a supply. Nevertheless, it is quite competent for any company, or even for a private individual, to supply electricity commercially without any legislative sanction. The Electric Lighting Acts are enabling only, and do not confer any monopoly upon those who have Parliamentary powers. As the conditions upon which a private undertaker supplies energy depend entirely upon the contract which he chooses to make, it is proposed to confine ourselves for the present to public supply. It may be mentioned, however, that by the Electric Lighting Act, 1909, which came into force on April 1st, 1910, no one is allowed to make a business of supplying electricity to his neighbours in any district where there is a provisional order already in force. The words "make a business" are used advisedly, for to supply current to a neighbour will be legal if the supply is merely ancillary to the ordinary business of the person who supplies it.

2. *Epitome of Rules as to the Supply of Electricity.*—The following rules, which are taken from the Electric Lighting Act, 1882, apply generally to the supply of electricity. Undertakers are not entitled to prescribe any special form of lamp or burner to be used by any company or person, nor must they in any way control or interfere with the manner in which electricity supplied by them is used. This is subject to the proviso that a consumer must not use any lamp or burner, or deal with the current supplied to him in such a way as to unduly or improperly interfere with the supply of electricity supplied to other consumers. The undertakers are bound to supply all consumers within their district on equal terms, and in making any agreements for supply they are prohibited from giving any undue preference to one consumer, or class of consumers.

3. *Legal Liability to Grant a Supply.*—The legal liability of a company to furnish consumers with a supply is further pointed out in Sec. 27 of the Schedule to the Electric Lighting (Clauses) Act, 1899, which is incorporated with every Provisional Order. That section provides that the undertakers shall furnish an adequate supply to every consumer within 50 yards of a distributing main of the undertakers in which they are required to maintain, or are maintaining, a supply of energy for the purposes of general supply. The necessary lines, &c., must be laid by the undertakers subject to the following conditions:—(i) The cost of all electric lines laid on the premises of the consumer, and (ii) the cost of so much of such connecting lines as it may be necessary to lay for a greater distance than 60 ft., are to be borne by the consumer if the undertakers so require. By Sub-Sec. 2 it is provided that each owner or occupier requiring a supply must (*a*) serve a notice upon the undertakers specifying the premises to be supplied, the amount required, and the date upon which the supply is to commence; (*b*) if required, contract to receive and pay for a supply of energy for a period of at least two years of such an amount that the payment to be made shall not be less than 20 per cent. per annum on the outlay incurred by the undertakers in providing electric connecting lines in accordance with this section; (*c*) if required, give security for the payment to the undertakers of all moneys which may become due to them in respect of lines and energy. It is further provided that undertakers may, at any time while they are supplying a consumer, by giving seven days' notice, require the owner or occupier to give security for moneys due and to become due. (As to supply of electricity to premises having already a separate supply, see paragraph 7 *infra.*)

4. *Supply within a Certain Area.*—Every local authority or company authorised to supply electricity was bound formerly to limit operations to its own district; it could not supply a single consumer outside. In one case (Attorney-General *v.* Metropolitan Electric Supply Co., 1905, 1 Ch. 24, 757), a limited company was authorised by statute to supply electricity within certain areas only, and also by a later statute to erect a station for generating electric current or electrical energy at a place outside those areas for the purpose of transmitting such current or energy therefrom to certain distributing stations within those areas, and for the purpose of supplying such current or energy within the same areas. It was held that the company, though incorporated under the Companies' Acts with unrestricted powers of producing and supplying electricity, was restricted by the Special Acts to the supply of electricity within the special areas.

In another case it was decided that a gas company had no right to supply gas outside the statutory area. A railway company had received gas at its terminus and sent it down the line to be consumed at another station down the line which was outside the area. It was held that this was illegal. It may be mentioned that on account of the inconvenience to which observance of the strict letter of the law has given rise, the Act of 1909 provides that, upon certain formalities being complied with, supply may be granted outside the area with the consent of the Board of Trade.

The difficulties and hardships suggested by these cases have been set at rest by the Electric Lighting Act, 1909, which provides that (1) any local authority, company, or person authorised to supply electricity in an area may, with the consent of the Board of Trade, supply at any point within that area electricity for the purpose of haulage or traction on any railway, tramway or canal, situate partly within and partly without that area, and for the purposes of lighting vehicles and vessels used on any such railway, tramway, or canal; but the Board of Trade shall not in any case give any such consent until notice of the application for the consent has been given by advertisement or otherwise in such manner as the Board of Trade may direct, and an opportunity has been given to any person who appears to the Board to be affected, of stating any objections he may have thereto.

The Board of Trade may by provisional order authorise any such local authority, company, or person so to supply electricity to be used for purposes incidental to the working or lighting of the railway, tramway, or canal, other than the purposes aforesaid.

It also provides that a supply to premises wholly without the area may be justified. Thus, where it is proved to the satisfaction of the Board of Trade that the occupier of any premises is desirous of obtaining a supply of electricity from any undertakers within whose area of supply those premises are not situate, the Board of Trade may, if the local authority within whose district the premises are situate, and the undertakers (if any) authorised to supply electricity to such premises, consent, by order permit the first-mentioned undertakers to give a supply to those premises on such terms and subject to such conditions as the Board think fit.

Provided that if, in the opinion of the Board of Trade, any consent required by this sub-section is unreasonably withheld, the Board of Trade may proceed as if such consent had been given.

5. *Regulations for Ensuring a Proper and Sufficient Supply of Electricity.*—The duties of a supply company are described in detail in the Board of Trade Regulations. According to those regulations, the company must give notice of their intention to switch on the current in the mains, and

must thereafter maintain a supply of sufficient power for the use of all the consumers for the time being entitled to be supplied. In case it becomes necessary to stop the supply through any portion of a main for more than one hour, the system must be so arranged that the disconnection does not exceed 200 KW. or extend to the premises of more than 80 consumers. The pressure of supply must not vary more than 2 per cent. from the standard pressure, while the variation of pressure at any consumer's terminals shall not under any conditions of the supply which the consumer is entitled to receive, exceed 4 per cent. from the declared constant pressure. As to fixing the standard pressure, the result of an inquiry held by the Board of Trade was that this may be altered, even without the consent of consumers, upon terms and conditions to be settled, in case of dispute, by an arbitrator appointed by the Board of Trade.

A number of interesting questions arise upon the interpretation of the above clauses and regulations with which it may be convenient to deal *seriatim*.

6. *Liability to Pay a Minimum.*—We have seen that a consumer may be bound to take and pay for a minimum supply of energy. Suppose he takes no energy for a whole year, can he still be compelled to pay the minimum amount? In the absence of any express authority on the point, it is submitted that the payment must be made, whether a supply is or is not taken. The object of the clause is to protect the undertakers, and it is clear that, whether a supply is taken or not, the initial expenditure will be just the same.

7. *Whether consumer not Bound to take Continuous Supply.*—The fact that a consumer had it in his power to keep the mains as a "stand-by" in case of the breakdown of a private installation, gave rise to considerable dissatisfaction amongst the undertakers. As a result, the Electric Lighting Act, 1909, contains a section providing specially for the supply of premises having a separate supply. The provisions of this section (15) are as follows:—Notwithstanding anything in the Electric Lighting Acts, or in any Act of Parliament or Provisional Order authorising an undertaking, a person shall not be entitled to demand or to continue to receive from undertakers authorised to supply electricity in any area, a supply of electricity for any premises having a separate supply, unless he has agreed with the undertakers to pay to them such minimum annual sum as will give them a reasonable return on the capital expenditure, and will cover other standing charges incurred by them in order to meet the possible maximum demand for those premises; the sum to be paid shall be determined in default of agreement by arbitration.

8. *Agreement not to Take Supply from Elsewhere.*—It is competent for undertakers to agree with the consumer that he will not take a supply from elsewhere during a certain period. Such an agreement has been upheld by the Court. In the Metropolitan Electric Supply Co. *v.* Ginder, 1901, 2 Ch. 799, the defendant had signed a form of request to the plaintiff company to supply him with electrical energy subject (*inter alia*) to the following terms:—(1) The consumer agrees to take the whole of the electrical energy required for the premises mentioned below from the company for a period of not less than five years; (2) The charge for electrical energy to be 4½d. per Board of Trade unit. There was no covenant by the company to supply, nor by the defendant to take any energy. Similar forms of request had been signed by other persons for different terms of years, and at different prices. After receiving a supply for some time on the above terms, the defendant gave notice to the company to disconnect, and received an instalment of energy from the County of London and Brush Provincial Co., who were rivals of the plaintiffs within their district. On threat of legal proceedings, he had plaintiffs' service reconnected, but he again gave notice to the plaintiffs to disconnect in February, 1901. The plaintiffs brought an action in the Chancery Division for an injunction to restrain the defendant from obtaining a supply from any source other than their own mains. Evidence was called on the part of the defendant to prove that the plaintiffs had failed to furnish a proper supply, and it was argued on the defendant's behalf that there could be no injunction to enforce a negative stipulation. It was decided by Justice Buckley (1) that the contract in this case implied an undertaking by the defendant not to take energy from anyone except the plaintiffs; (2) That the contract was one which could lawfully be imposed upon the defendant by virtue of the plaintiffs' provisional order; (3) That the provisions of the Electric Lighting Act, 1882, Secs. 19 and 20, which compel a supply company to give a supply to a consumer on the terms upon which any other person in the area "is entitled under similar circumstances to a corresponding supply," had not been infringed; and (4) that the plaintiffs were entitled to an injunction.

This was a case in which the consumer took energy from other undertakers. It is presumed that if he had erected a private installation on his own premises, and had obtained energy therefrom during the period in question, he could in that case have been restrained by injunction.

9. *Methods of Ascertaining Amount of Energy Supplied.*—The amount of energy supplied by undertakers to their consumers is to be estimated, in the absence of agreement, by meters. The Board of Trade does not undertake to inspect meters, it being provided in the rules issued by the Electrical Standardising Laboratory, 1897, "That meters for the measurement of quantity of energy cannot be received with a view to certification for use in connection with the supply given by undertakers under Electric Lighting Orders." It is provided, however, by Sec. 51 of the schedule to the Clauses Act that any consumer, on paying the required fee, may employ an inspector to examine any meter, and to certify it as a "certified meter."

10. *Agreements between Company and Consumer.*—An agreement made between an electric supply company and a local authority for the supply of electricity should generally contain a penalty clause. By Sec. 174, Sub-Sec. (2) of the Public Health Act, 1875, it is provided that every contract made by an urban authority whereof the value or amount exceeds £50, "shall specify some pecuniary penalty to be fixed in case the terms of the contract are not duly performed." This provision is obligatory and not merely directory, and if the penalty is not specified, an action on the contract against the local authority cannot be maintained (British Insulated Wire Co. *v.* Prescot Urban District Council (1895), 2 Q.B. 463, 538).

It has been decided that where a company contracts to supply energy on special terms under Sec. 83 of the Electric Lighting (Clauses) Act, 1899, the consumer may sue for breach of contract if there is a failure of supply. He need not confine himself to the recovery of penalties (Morris and Bastert *v.* Loughborough Corporation, 1908, 1 K.B., 217).

The importance of entering into a contract with the undertakers was well illustrated in the case of Husey *v.* The London Electric Supply Corporation (1902; 18 T.L.R., 296). In that case a receiver appointed by the High Court in a debenture-holder's action against the St. Ermin's Hotel Co. entered into possession of the hotel which was then being carried on by the company. At the time when the Receiver entered, the hotel company owed a sum of £437 to the defendants in respect of electric current which had been supplied for the lighting of the hotel. The Receiver entered into no fresh contract with the supply company, nor would he pay the arrears. Consequently the supply company threatened to disconnect the hotel from their mains, and an action was brought to restrain them from so doing. In was argued on their behalf that if the Receiver were a new occupier of the hotel, he was bound to enter into a new contract before he could receive a supply, and that, if his occupancy was a mere continuance of that of the hotel company, the defendants were entitled to disconnect until the arrears were paid. Mr. Justice Kekewich granted an injunction, but his judgment was reversed in the Court of Appeal, where Lord Justice Vaughan-Williams said: "In my view, it is plain that, under the Act of 1882, no one is entitled to demand a supply of electric current until he has entered into a contract with the company which supplies it. If there has been no change in the occupancy of the hotel, then, *a fortiori*, the defendants ought not to be restrained 'from cutting off the supply.'"

In the above case, the Receiver either represented the old tenant, and was therefore liable to pay such rent as was in arrears, or he was a new tenant, not entitled to be supplied until he entered into a contract for that purpose with the company.

(*To be continued.*)

BUSINESS NOTES.

Argentina.—Although the general trade of Argentina in the first quarter of 1912 showed a shrinkage, the imports of electrotechnical articles were marked by decidedly enlarged figures, having advanced from 977,000 gold pesos in the same period in the previous year to 2,263,000 gold pesos in the first quarter of the current year. The increase was observable not only in dynamos and motors, but also and especially in accumulators, measuring instruments, and materials for electrical purposes. The increase in accumulators was owing to the large orders by the Deutsche Uberseeische Electricitäts-Gesellschaft in the quarter under review. Including various not specifically electrotechnical products, the aggregate imports of the articles grouped under "electrotechnical products" amounted to 2,263,122 gold pesos against 1,286,122 gold pesos in the first quarter of 1911. In detail, electrical machines and motors were imported to 566,531 gold pesos, an increase of 393,298; electric fans, 6,120, an increase of 1,464; accumulators and batteries, 757,161, increase 146,847; current and pressure meters, 4,678, increase of 1,388; electric bells, 5,891, increase 339; electric meters, 104,628, increase 54,396; arc lamps, 19,264, increase 20; glow lamps, 107,324, increase 492; lamp fittings, 16,855, increase 6,966; carbons, 25,291, increase 14,246; materials for electric purposes, 160,151, increase 108,938; and porcelain, clay and glass insulators, 25,262, increase 6,893. Articles showing shrinkage were—Small motors, 4,080, a decrease of 1,576; wire and cable, 558,830, decrease 17,531; telegraph and telephone apparatus, 10,536, decrease 9,337; switches, &c., 40,771, decrease 26,979; conduits, 36,862, decrease 12,741; and material for telegraph and telephone installations, 11,069, decrease 1,099.—*Electrotechnische Zeitschrift.*

Canadian Manufactures.—Lord Strathcona, High Commissioner for Canada, has just received from the Census and Statistics Office at Ottawa a bulletin stating that the census of the manufactures of Canada taken last year for the calendar year 1910, as now compiled, gives the following comparative statistics, compared with those of the census of 1901 for the calendar year 1900, viz.:—

	1910.	1900.	*Increase.*	*Increase.*
Establishments ...	19,202	14,650	4,552	31·07 %
Capital ...	$1,245,018,881	$446,916,487	$798,102,394	178·58 %
Employés ...	511,844	339,173	172,671	50·91 %
Salaries and wages ...	$240,494,996	$113,249,350	$127,245,646	112·36 %
Materials ...	$600,822,791	$266,527,858	$334,294,933	125·42 %
Products ...	$1,164,695,032	$481,053,375	$683,641,657	142·11 %

The capital employed in manufactures increased during the decade by 178·58 per cent., and the value of products by 142·11 per cent. The number of establishments employing five hands and over last year was 19,202, being an increase of 4,552 in the decade.

Canadian Trade.—Among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17, Victoria Street, London, S.W., during the week ending August 26th, were the following:—

A firm in South Wales who are about to commence the development of a mica property in India, are open either to do business with Canadian importers, or to dispose of the property to a Canadian company.

The City Commissioner of an important Western Canadian city will be in London in September, and is desirous of getting into touch with manufacturers of large gas engines to be used for the purpose of generating electric light and power.

An important Canadian company who are dealers in motor boat accessories desire to get into touch with United Kingdom manufacturers from whom they could purchase. They are particularly interested in ignition cable, brass propellers, marine accessories, and lamps. A catalogue of what is required can be seen at the Canadian Government Office, as above.

Consular Notes.—Nicaragua.—The American Consul at Corinto reports that the National Electric Signal Co., of Pittsburg, Pa., has corresponded directly with the Nicaraguan Government relative to the establishment in Nicaragua, at its risk, of several wireless stations. The company is the one which put in the stations of the United Trunk Co., and is now taking up the matter of establishing a number of others along the Atlantic coast of Mexico and Central America, for the purpose of obtaining constant communication between these countries and the United States. The company also offers to put in at Managua a wireless tower of sufficient power to communicate with Salvador. The engineers were to leave for Nicaragua in May to carry out the work.

France.—The British Consul at Lyons, in a recent report, states that the development of the resources latent as water-power in the mountain streams of South-Eastern France continues to make rapid progress, and it is estimated that no less than 475,000 H.P. is now generated by the various hydro-electric works in the French Alps, with a minimum at winter low water of 180,000 H.P. The employment of this power may be distributed as follows:—Metallurgical works, 210,000 maximum H.P.; light and power, 155,000; chemical products, 60,000; paper and wood pulp, 30,000; traction, 10,000; various, 10,000; making a total of 475,000 maximum H.P. Of this total about 356,000 H.P. maximum and 136,820 minimum H.P. are produced by the river systems in the Lyons Consular district, chief among them being the Isère and its numerous feeders, the Arve and the Rhône. In addition to this large aggregate of power actually generated, fresh streams are being harnessed representing many thousands of horse-power; chief among these schemes may be mentioned one for obtaining from the waters of the Drac to the south of Grenoble, an average of 10,000 H.P., by means of a dam, from which the collected water will be carried through a tunnel 250 yards long, and then along conduits for nearly 4 miles to a power house in Grenoble itself. It is expected that the electricity thus generated will be used for lighting the town. Another enterprise nearer Lyons contemplates the erection of works on the Fier at its junction with the Rhône for generating 10,000 H.P., which will be conveyed to industrial works at Port de Cherery (Isère) for motive power, and to Lyons for lighting purposes. Previous reports have described the scheme for the construction of a dam 220 ft. high across the Rhône at Genissiat, below Bellegarde, at an estimated cost of £4,800,000 for the generation of electric power, estimated at a maximum of 326,000 H.P., which would be conveyed by overhead wires under the enormous pressure of 120,000 volts to Paris, and in last year's report, extracts from which were given in the ELECTRICAL REVIEW, reference was made to the hostility which had been aroused locally by this scheme for carrying off to Paris the energy latent in the waters of the Rhône, which is considered to be the natural heritage of the neighbouring districts. This opposition, so far from diminishing, gathered momentum throughout 1911, and has found expression in a regularly organised campaign against the granting of the concession, in which Lyons and the Department of the Rhône have taken a prominent part. The opponents of the Genissiat scheme are for the most part in favour of the counter-project aiming at the construction of two smaller dams, one below the other, for generating power for more local use. Nothing, however, has as yet been settled, though it would appear that the central authorities are more favourably disposed towards the Genissiat-Paris power concession than towards an alternative, which would only benefit the immediate neighbourhood and would bring no advantage to Paris. The eternal jealousy between Paris and the provinces, aroused by this threatening filching of Rhône water-powers for the benefit of the capital, was further inflamed towards the latter part of 1911 by the publication of a scheme laid before the Paris Muncipal Council for carrying off from the Lake of Geneva, water required to make up existing deficiencies in the supply of the town, to the amount of 2,000,000 cb. m. (70,632,000 cb. ft.) every 24 hours, or 730,000,000 cb. m. (25,780,680,000 cb. ft.) a year. This proposal raised a perfect storm of protest, not only from Lyons, whose water supply, already seriously defective at times of low water, would be materially compromised, but also from nearly all the riverain districts between Lyons and the sea, on the ground that it would lower the height of the water by from 15 to 20 centims., and would be highly detrimental not only to the navigation of the river, already difficult enough, but to its utility for irrigation purposes in the more southern districts. It is alleged indeed that such a tampering with the stream would substantially increase the number of days in the year on which, by reason of the lowness of the water, no navigation on the Rhône is possible. The present position of the matter is that the Minister of Public Works, in answer to a question in the Chamber of Deputies, has denied any official knowledge of it; but the various bodies interested are still on their guard, and a formidable agitation is being steadily organised under the hegemony of the Lyons municipality, in order to weld into a solid front of opposition the hostility which the scheme has aroused in the 10 riverain Departments of the Rhône.

Proposals have also been on foot for the development of the navagibility of the Rhône. Two separate schemes have been put forward in recent years, both of which, are more or less bound up with hydro-electric development. The first of these was the result of deliberations of a committee representing the various departments interested and contemplated the erection of a canal from Lyons to Arles at an estimated cost of £12,000,000, which would serve the double purpose of facilitating navigation and providing electric power by utilising the fall of water in the numerous locks. By this means it was estimated that 60,000 H.P. could be generated from 12 power houses at different points along its banks, which could be disposed of for lighting and industrial purposes and bring in a large revenue. The other scheme was propounded by the chief engineer of "Ponts et Chaussées" at Lyons and was of the same nature, with this difference, that the current would be much slower and easier for navigation, while as a consequence the generation of electricity would play a much smaller part—only some 5,700 H.P. being expected to be derived from the fall at the locks—while the cost was estimated at the enormous total of £20,240,000. Neither of these schemes having commended itself to the authorities, a competition was organised in 1909 under the auspices of the Lyons and Marseilles Chambers of Commerce for encouraging the drawing up of further projects and prizes amounting to £2,000 are to be awarded for the best solution of the difficulties with which the question bristles. No announcement on the subject has up to the present been made by the Office des Transports du Sud Est, which was created for the purpose of dealing with this and kindred questions, but, meanwhile, a third scheme has been propounded which would substitute for a lateral canal a series of dams, 25 to 30 in number, across the Rhône itself at regular intervals between Lyons and Arles, each provided with a large lock capable of accommodating vessels of large draught and tonnage; at a power house in connection with each lock electricity would be generated from the fall of some 19 ft. By this means it is estimated that from 400,000 to 1,000,000 kilowatts could be obtained, according to the height of the water, from which a considerable revenue might be derived. A minimum depth of 13 ft. would be maintained, enabling vessels of much larger draught to navigate the river than would be possible with a lateral canal. The scheme includes facilities for

irrigating the land on both banks—an almost indispensable feature of any project likely to commend itself for acceptance, as water is badly wanted in the arid Southern Departments through which the Rhône passes.

Portuguese East Africa.—The British Vice-Consul at Lobito reports that the electrical distributing plant, consisting of transformer stations, at Catumbella, Lobito and Benguella, and the poling and wiring for street lighting at these three places, were completed towards the end of 1911, under the supervision of the contractors, Messrs. Johnson & Phillips, Ltd., of London. Owing to there having been little or no rain during 1910-11 wet season, the water in the River Catumbella was lower than ever remembered by the oldest residents; consequently conditions were never so favourable for the completion of the dam, but it was nowhere near completion when the heavy rains of October commenced. The result was that the temporary dam protecting the foundations in course of erection for the power house was carried away, and all pumping plant washed into the river bed. At the end of January the contractors sent out an hydraulic engineer, and work was resumed, the rise of water due to the October and November, or small rains, having subsided. Parts of the foundered pumping plant were recovered, and work was started on a new temporary dam.

Canary Islands.—The American Consul at Teneriffe reports that the Electric Tram Co., composed of Belgian capitalists, and employing modern methods and equipment, materially improved its system all along the line last year. The 15-mile extension from Tacaronte to Orotava has not been carried out, and the prospect looks forlorn, for the reason that, besides being an expensive road to build because of the unusual gradients, the company would, as heretofore, have to give the Government the usual 25 per cent. of the gross receipts. As this leaves a very small margin of profit at present, it would leave still less, if any, on the road projected. The completed portion of the road consists of two sections of approximately 7 miles each, from Teneriffe to Laguna, and again from the latter place to Tacaronte. Laguna has 15,000, and Tacaronte nearly 3,000 inhabitants; both have altitudes of over 1,800 ft. The power works are situated at Cuesta, a village with an altitude of about 600 ft., nearly midway between Teneriffe and Laguna. This work is elaborate and up-to-date. Two engines (direct-coupled) drive the 200-KW. dynamos (Dulait system). Galloway boilers, Green economisers, and Tudor accumulators are included in the equipment. The condensing water is cooled by a tubular refrigerator (Koerting system). On account of the steep inclines, each car is equipped with two 50-H.P. motors. Apart from the actual beauty of the journey, the ride is interesting as an example of modern Belgian electrical engineering.

Holidays.—The works and offices of FERRANTI, LTD., at Hollinwood, will be closed this evening (August 30th), until Monday morning, September 9th. A small staff will deal with urgent correspondence.

Diesel Engine Orders.—We learn that the M.A.N. Co. have recently received orders for the following M.A.N. Diesel engine plants:—

Belliss & Morcom.—One horizontal engine of 120 B.H.P.
Colombo Tramways.—One vertical engine of 240 B.H.P.
Société de l'Air Comprimé, Paris.—One horizontal engine of 2,000 B.H.P. and one vertical engine of 150 B.H.P.
A.E.G. Thomson-Houston, Iberica, Madrid.—One vertical engine of 290 B.H.P. (repeat order).
Central Station of the Rio de la Almeda, Mexico.—Two horizontal engines of 1,500 B.H.P. each.

Prices Advance.—Owing to recent increases in the cost of raw material, the BRITISH THOMSON-HOUSTON CO. have made a 5 per cent. advance in the prices of all their wires and cables, taking effect from August 21st.

Bankruptcy Proceedings.—ALFRED SLATTER, electrical engineer and agent, Bridge Street, Blackfriars, S.E.—The public examination was held last week before Mr. Registrar Hope, at the London Bankruptcy Court. The receiving order was made on June 24th at the instance of a creditor and a statement of affairs has been submitted by the debtor showing total liabilities £3,112, of which £2,003 is expected to rank for dividend, against assets valued at £198, apart from book debts to the face value of £1,441, but returned as irrecoverable. Questioned by Mr. J. B Knight, Official Receiver, the debtor stated that in 1887 with a capital of about £500, he commenced in business as an electrical engineer and agent for telegraph material at 4, St. Mary Axe, E.C. The business was at first successful, his net profits averaging about £500 a year, but owing to the severity of competition, he gave it up in 1892. Witness next obtained an appointment as manager to an electrical company at a salary of £300 per annum, and in 1898 he resigned that appointment to accept a similar one bearing a salary of £400 a year. Whilst in business on his own account, witness became indebted for £650 to a Mrs. Garry, who advanced him that amount for the purpose of the trading; he was to retain the loan for his lifetime in consideration of paying interest regularly, and of educating her son as an electrical engineer. Since 1895 witness had acted as chairman of the Wycombe Borough Electric Light and Power Co., Ltd., at a salary of £35, and of the Chesham Electric Light and Power Co., Ltd., at a salary of £20 per annum. Asked if he were a director of the Wycombe Co., the debtor replied that he was the originator of the scheme. He added that he was not the promoter of the Chesham Co., but obtained the sanction from the local authority. He held shares in the Wycombe Co., but they were pledged in 1906. In 1902 witness commenced business as a consulting electrical engineer at Bridge Street, Blackfriars. He had also been interested in the construction of a railway in Mexico. Then in August, 1910, witness obtained an option to acquire water rights in the State of Oaxaca, Mexico, for the development of a hydro-electric transmission installation; in December, 1911, he entered into a contract with a French banking firm, who were to provide £400,000 for constructional purposes, to pay him £15,000 by March 25th, 1912, and to issue to him £100,000 of the common stock of the company. The French bankers, however, failed to carry out their agreement, and the option lapsed in February, 1912. Witness had to provide for the whole of the expenses of obtaining and preserving the concession, which necessitated raising money from friends and professional moneylenders—from the latter at heavy rates of interest—and in all he had expended about £2,000 on the scheme. A judgment of £75 was obtained against him last February by professional moneylender, and a petition was subsequently presented, upon which the receiving order was made. The debtor attributed his failure and insolvency to the failure of the French bankers to carry out their agreement to finance the Oaxaca scheme. The examination was concluded.

T. E. MORGAN, electrical engineer, Ecclesall Road, Sheffield.—First and final dividend of 20s. in the £, plus 4 per cent. interest payable August 26th, at Official Receiver's Offices, Figtree Lane, Sheffield. This sort of thing is always good to read. May we be excused if we put aside our editorial reserve, and say "Bravo!" The failure was only of the proportions of the excusing servant's baby, and the proceedings were reported in our pages as long ago as December, 1902. We wish it were our duty to record full settlement, even after many days, a little more frequently.

According to a notice in the *London Gazette*, the estates of FRANCIS MCKAY, electrical engineer, 25, Elmbank Crescent, Glasgow, were sequestrated on August 24th. A meeting to elect trustee and commissioners will be held on September 4th at Glasgow, and a composition may then be offered.

JOHN TIZZARD, electrical engineer, Torquay.—Last day for receiving proofs for dividend, September 20th. Trustee, Mr. A. E. Ward, 9, Bedford Circus, Exeter.

Book Notices.—"*Proceedings* of the American Institute of Electrical Engineers." August, 1912. Vol. XXXI, No. 8. New York: The Institute. Price $1.

"The Central." August, 1912. Vol. IX, No. 28. Reading: Old Centralians Association. Price 1s. 6d.

"Year-Book of the Michigan College of Mines." 1911-12. Houghton, Mich.: The College. 1912.

"*Journal* of the Franklin Institute." August, 1912. Vol. CLXXIV, No. 2. Philadelphia, Pa.: The Institute. Price 50 c.

"*Journal* of the U.S. Artillery." July-August, 1912. Vol. XXXVIII, No. 1. Fort Monroe, Va.: Coast Artillery School Press.

"Handbuch der Elektrizität und des Magnetismus." By Prof. Dr. L. Graetz. Leipzig: J. A. Barth. Price M. 6.

"*Proceedings* of the Forty-fifth Annual Convention of the American Institute of Architects." 1911. Washington: The Institute.

"*Journal* of the Western Society of Engineers." Vol. XVII, No. 4. April, 1912. Chicago: The Society.

"The Motor-Generator: In Theory and in Practice." By J. W. Barber. London: Ganes, Ltd. 1912. Price 1s. net.

"Mémoires sur L'Electricité et L'Optique." By A. Potier. Paris: Gauthier-Villars.

"*Journal* of the South African Institution of Engineers." Vol. X, No. 11. June, 1912. Johannesburg: The Institution. Price 2s.

The Finsbury Technical College Old Students' Association *Magazine* for August mentions that Mr. R. J. Wallis-Jones has presented to the Association (of which he is past-president) the dies for a handsome medal, which he will present to the author of the best paper read by a member of the Association during the year ended June 30th, 1912. Such papers must be sent to the Hon. Secretary not later than 31st inst.

"Life Understood." By F. L. Rawson, M.I.E.E. 1912. London: The Crystal Press. Price 7s. 6d. net.

The A.E.G. in Mexico.—The A.E.G. Co. have founded a subsidiary company in Mexico with the title of "A.E.G. Compania Mexicana de Electricidad S.A." This company's sphere of operations will not be confined to Mexico alone, as it will operate in Cuba and Central America as well. Its managing directors will be Messrs. Friedrich von Bluecher and Otto Ruesche.

Ductile Filament "Goblin" Lamps.—MESSRS. DAVID SMITH & CO., of 2 and 3, Red Lion Court, E.C., inform us that they have now an improved lamp on the market, the filaments of which are stronger than anything yet produced, and even after burning 2,000 hours are found to be as flexible as before use. Other special features are that the lamp will not blacken under any conditions; also, it will not sag, and it can be used at any angle. According to a test at the National Physical Laboratory on six lamps of 205 volts, 32 to 36 watts, the average wattage is 1·27 British standard candle-power. The lamps can be made any size or shape required, and all standard voltages and candle-powers are kept in stock at the company's London warehouse.

Liquidation.—TRACTION SUPPLIES CO., LTD. (in liquidation).—At the meeting of creditors, held on August 15th, the statement of affairs as at July 30th, 1912, showed liabilities as follows:—Share capital issued, less £3 calls unpaid, £2,200; secured creditors, &c., including debentures (£700), £720; unsecured creditors, £1,175. The assets, consisting of stock-in-trade, plant and machinery, work in progress, fixtures and fittings, patents and debtors, all as shown in the books,

amounted to £3,116, and were estimated to produce £945; cash in hand, £2. Deducting the amount of secured and preferential creditors, £720, there was left for the creditors and the cost of winding up £227. A scheme of reconstruction was submitted by Mr. White, the manager of the company, which proposed that the creditors should agree to accept payment of their accounts in instalments, amounting to 10s. in the £, and take preference shares in the company for the remaining 10s. in the £. A committee was appointed to confer with the debenture-holders in regard to the scheme, and a meeting took place on the 21st inst., but as debenture-holders representing £460 of the £700 debentures were were not in favour of the scheme, it was decided to ask all the debenture-holders to meet the creditors at their adjourned meeting on the 26th inst., to discuss the scheme. This meeting took place on August 26th, but as there was no change in the attitude of the debenture-holders in regard to the scheme, a resolution was passed confirming the appointment of Mr. Thomas Metcalf as liquidator, and electing an advisory committee of three, consisting of Messrs. C. Bertram (Henley's Telegraph Works Co., Ltd.), H. Barkes (British Electrical and Manufacturing Co., Ltd.), and A. L. Cook (Cook, Bros.), representing the creditors, to assist the liquidator.

Catalogues and Lists.—Messrs. Souper and Callaghan, 16, Deansgate, Manchester.—Illustrated leaflet relating to a new workshop combination tool, combining on a single bedplate the following:—Rotary blower forge, anvil, mechanic's vice, pipe vice, emery wheel and drill press.

The Electrical Co., Ltd., Charing Cross Road, London, W.C.—Thirty-two-page pamphlet entitled "Sunshine after Sunset," giving very full particulars of the "Sunshine" flame arc lamps, their construction, operation, users, prices and so forth.

Messrs. Simplex Conduits, Ltd., 116, Charing Cross Road, London, W.C.—Sixty-four-page pocket list, containing a large amount of illustrated matter, together with prices, of their Holophane globes and reflectors. In addition to their standard line reflector bowls, sphere globes, and residence reflectors, there are the new "Bank" and Billiard lighting units, Holophane-Benjamin steel reflectors for mill and factory lighting, the new "Uniflux" reflector for picture lighting, &c. Information is published regarding use, spacing, light distribution (with curves), &c. Copies of the booklet will be supplied overprinted with contractors' or supply companies' names.

The Schniewindt Electric Co.—Illustrated leaflet describing their "Stangerotherm" electro-medical specialities, and the manner of their application. Copies can be obtained on application.

The Phelps Manufacturing Co, Detroit, Mich., U.S.A.—Bulletins relating to motorless flashers for electric advertising and other signs, also to small electric-heating devices.

Messrs. Ferranti, Ltd., 78, King Street, Manchester.—Eighteen-page illustrated list (No. H302) relating to totally enclosed high-tension ironclad panels, the matter being arranged in a special manner to facilitate cabling orders from abroad.

Trade Announcements.—The Walsall Electrical Co., Ltd., announce that, owing to Mr. S. H. Fielden, their London agent, having decided to go abroad, they are at present unrepresented in the London district. All inquiries should be forwarded direct to Walsall for the present.

The North-West Electrical Appliance Co., of Railway Appliances Works, Darlington (formerly of Glasgow), have changed the name of the firm to the Arc Lamp Lowering Gear Co. There is no alteration in the management, &c., of the business.

The British Thomson-Houston Co., Ltd., have opened a branch office at 25, Suffolk Street, Dublin (Tel. No. 1557), where they will hold a complete stock of lamp and wiring supplies.

The business of Jens Orten-Boving & Co. will henceforth be carried on under the title of Boving & Co., Ltd., the latter company having been formed, with a capital of £60,000, one-half in preference and the other half in ordinary shares. The change has been made in order to facilitate dealing with the great growth in the business. The partners in the old firm (Messrs. Jens Orten-Boving and Douglas Spencer) will act as joint managing directors in the new company. The business will be conducted on the same lines as before through the London office (9½, Union Court, E.C.), and through the various branch offices abroad.

From to-morrow, 31st inst., the Electrical Accessories Department of the Metallic Seamless Tube Co., Ltd., will remove from the works to more central premises at Meta House, 153, Corporation Street, Birmingham. Telegraphic address: "Meta, Birmingham"; Telephone No.: Central, 3414. Larger stocking facilities and a fittings showroom will be among the features of the new premises.

Mr. H. Gielgud has transferred the goodwill of his iron and steel merchant business, also his agency for the Société Anonyme des Acieries d'Angleur, of Tilleur, Belgium, to Messrs. Andrew Brown & Co. (successors to H. Gielgud), 7A, Laurence Pountney Hill, E.C.

Mr. G. H. Baker is commencing business as a lighting engineer at 59, Station Road, Bexhill-on-Sea.

South America.—The *Review of the River Plate* says that the Government has authorised the Sociedad Anonima A.E.G. Cia. Sud Americana de Electricidad to open a branch in Argentina. This is a branch of the A.E.G. Co., of Berlin, which has hitherto been represented in the market by an agency.

Stock List.—The Victoria Dynamo and Motor Co., of Craven House, Kingsway, London, W.C., are holding a large stock of standard A.C. and D.C. motors for immediate delivery. Their August stock list appeared in our advertisement pages last week.

LIGHTING and POWER NOTES.

Acton.—At the last meeting of the Council, the chairman reported that the Metropolitan Electric Supply Co. had intimated that, subject to a settlement being come to as to the terms for the supply of electricity for main street lighting and sewage pumping, it would accept the final offer of the Council of £3,000 in full settlement of all outstanding disputed items on either side in connection with the transfer of the local undertaking. Accordingly, an interview was arranged between representatives of the Council and the company, and, as the result, the following recommendation was submitted to the Council for confirmation: "The confirmation of the Council's final offer, with the following alterations or variations: (*a*) The company to continue to supply electricity to the sewage pumping station (with no restriction as to user by the Council, who will use their best endeavours to avoid the pumps being used during the peak load except in cases of emergency) at the present flat rate of 1¾d. per unit; (*b*) the Council to accept the company's offer for main-street lighting for five years, viz., 94 lamps of 450 c.p. each, at an annual cost of £900; (*c*) the amount of rent for the site of the generating station to be settled by a friendly arbitration between the Council and the company; (*d*) the wayleave for the cables through the Acton Park, in the amended line agreed, be granted by the Council in accordance with the terms of the draft agreement already settled between the parties, and the seal of the Council affixed to an engrossment of the same in time for the company to commence work by September 1st, 1912." On the question being raised at the interview, it was mentioned that the company would be prepared to supply electricity to all the Council's buildings at present lighted by electricity, excluding the Council offices, library and baths, at a flat rate of 4d. per unit, but no recommendation was made thereon. The chairman, in moving the adoption of the recommendations, said that the Council had before it the very best that could be done. Councillor Poulton said he hoped the agreement would not be accepted, as he did not see why the company should have the lighting of the main roads when the gas company had offered to do it for £500; nor did he approve that part of the agreement which was to allow the company to charge at the rate of 1¾d. per unit for current at the pumping station. He thought the Council ought not to pay more than 1¼d. The Chairman stated that he himself did not like the terms, but it must be remembered that the position was that the Council either secured the £5,710 from the company or went to law and fought for it. In the result, Councillor Poulton withdrew his opposition, and the recommendations, with a slight amendment, were carried.

Argentina.—The Mayor of Buenos Ayres has signed an *ad referendum* contract with the Cia. Italo-Argentina de Electricidad for establishing electric light and power stations in the Federal capital. The concession is for 50 years, at the termination of which the Corporation can take over the plant, paying the amount of capital not amortised; or, on the other hand, the concession can be extended for a further period of 25 years, at the end of which all would revert to the Corporation without cost. If the latter project is adopted, the company will pay the Corporation 6 per cent. of its gross revenue and 15 per cent. of its profits.—*Review of the River Plate.*

Barton-on-Humber.—The U.D.C. has accepted the offer of Mr. F. Hopper, on behalf of a local syndicate, for public lighting by electricity from August 1st, 1913, at £2 2s. per lamp per annum.

Belfast.—On and after October 1st, electricity used for driving machinery in connection with lighting apparatus will be charged for at the current rates for lighting, and all consumers at present being charged at power rates for the same purpose will be charged at lighting rates.

Blackpool.—The Electricity and Street Lighting Committees have decided to illuminate the new Princess Parade during the whole of September. The smaller gardens will be pointed out with vari-coloured electric lamps, the whole of the parade being encircled with fairy lights. Some 12,000 electric lamps will be employed, and the two Committees have agreed to bear the cost of the scheme, the illumination to be on the scale employed during the festivities which accompanied the opening of the parade in May, by H.R.H. Princess Louise.

Brazil.—The firm of Buxton, Cassini & Co. are erecting an electric power station at Pelotas, Rio Grande do Sul.

Canada.—According to the *Standard* correspondent, the Canadian Light and Power Co. has secured the assent of the shareholders to an increase in the capital stock from $6,000,000 to $7,000,000. The company, which is a subsidiary of the Montreal Tramways and Power Co., will complete a dredging project in the Beauharnois Canal this autumn, which will give them a total of 30,500 H.P. The company has been operating to part of this capacity since the beginning of the year. Once the present work is completed it is understood that the flow of water and the amount of power which the company can develop will be increased by further dredging operations and enlargement of plant. The Shawinigian Water and Power Co., which delivers power in Montreal from a distance of about 100 miles, is asking the consent of its shareholders to an increase in its stock issue from $10,000,000 to $15,000,000. The company last year completed a new installation of two units of 15,000 H.P. each, bringing the capacity of the plant up to 85,000 H.P. It is presumed that the increase in capital will be to install three further units of 15,000 H.P. provided

for in the recent development. The Cedar Rapids Power and Manufacturing Co., which is now building a plant at Cedar Rapids, is understood to be about to close two contracts for 50,000 H.P. each, to be delivered on the completion of the plant in about two years' time.

Cavan.—The Urban Council is proceeding with the scheme for electric supply to the town, both for public and private lighting.

Continental Notes. — AUSTRIA.—The Poetovia Co. located at Pettau in Steiermark has secured the concession to utilise the water-power of the River Drau, from Pettau to Friedau, for a period of 90 years. This section, 30 km. in extent, comprises the best portion of that river. The plans, drafted by the Swiss engineer, S. Spychiger, contemplate the transmission of 65,000 H P. over a distance of 240 km, at a pressure of 110,000 volts. The power stations will be equipped with seven Francis turbines, each with an output of 6,600 H.P., giving an 8-monthly capacity for the first power house equal to 39,400 H.P., and for the second, 25,600 H.P., or a total of 65,000 H.P. The Oesterreichischen Siemens-Schuckert Werke have prepared the plans for the generating plant, the pressure at the terminals being 10,000 volts and on the mains 110,000 volts. The undertaking has been designed to serve the whole of Steiermark, including that part of Lower Austria, where are situated the densest and most numerous industrial populations, but near the stations the call for current is relatively small. The total cost of the scheme, including concession, plans, &c., is estimated at 20,000,000 kronen, or 500 kronen per horse-power at the turbines.—*Electrotechnick und Maschinenbau.*

FRANCE.—According to the *Standard*, several districts in the most fashionable part of Paris were thrown into darkness on Sunday night by the rupture of an electric cable of the Place Clichy section. All the large hotels, cafés and restaurants in the Champs Elysée's quarter were affected.

It was at first thought that "King" Pataud, the director of the electricians' strike in Paris last year, was again becoming active.

A new company has just been formed at Nancy, with a capital of £40,000, and the title La Société de l'Energie Electrique de l'Est.

GERMANY.—The efforts made by the Uberlandcentrale zu Mulhausen, a private company, to develop the use of electrically-driven weaving machinery in the Eichfeld district, have met with a fair measure of success. Some 20 installations have up to the present been made. It is expected that within a measurable period the whole of the hand looms in use by the villagers in the Eichfeld district will be superseded by electrically-driven machines, as it becomes recognised that the quality of the woven product is better, and the output of the individual weaver is greatly augmented.

ITALY.—There is great discontent amongst the consumers outside the town of Modena in consequence of the insufficient supply of electrical energy for manufacturing purposes Unless a better supply is provided, some of the factories threaten to close.

A referendum of the town of Bagnocavallo has been taken on a proposal to adopt municipal electrical works for the town. The vote is in favour of the proposal.

The Adriatic Co. is completing the electrical installation in the town of Badiu-Polesine, which will be inaugurated during the autumn. Also the inter-provincial installation of telephones in the district is being rapidly proceeded with and will in a short time be completed.

Messrs. Bianchi, Steiner & Co., of Milan, have applied to the prefectural authorities of Belluno, for a concession to utilise the water-power of the River Piave al Mel in the generation of electrical energy for lighting and power purposes in the town of Fener. It is stated that about 6,000 H.P. will be available.

SPAIN.—A company has been formed in Paris under the style of the Energie Electrique du centre de l'Espagne, with a capital of 1,250,000 fr. for the purchase, building, and working of power stations for the generation and distribution of electric current for lighting and power purposes, primarily in the centre of Spain, but optionally elsewhere.—*L'Industrie Electrique.*

Doncaster.—The R.D.C. has decided to accept the offer of the Manvers Main Collieries, Ltd., for lighting by electricity the roads from the Swinton and Knottingley Railway Bridge, Roman Terrace, to Wath Crossing, and from Adwick Sidings to Hound Hill Bridge, Adwick-on-Dearne.

Dudley.—At the next monthly meeting of the T.C., the members will consider an offer to purchase the Corporation's electric light undertaking, which was founded in 1899 in order to carry out what became well known amongst municipalities as the "Dudley Tramways Agreement." The substance of this was that the Council should supply electrical current for the whole of the tramways within the borough; that it should subsequently purchase when completed, the tramways and rolling stock of the British Electric Traction Co., which constructed the lines, and lease the same to the company for a period eventually settled at 30 years. Up to date there has been spent upon the works £98,460. From 1903 till 1909 the undertaking returned an annual profit of about £500; but the Committee, it is stated, never made any allowance for depreciation of plant. The net profits were consequently held in reserve, and have been absorbed. In 1910 there was a loss on the year's working of £600. The report issued in March, 1911, stated that the income had been £13,000, as against £12,091 in the previous year, making the gross profit £5,959, an increase on the year of £135. The undertaking had been, however, debited with £500, the cost of a B. of T. arbitration, which had reduced the price of current supplied for tramway purposes, and the loss on the year's working was £1,206. But for the arbitration and its unfortunate result, it was noted that there would have been a net profit of £302. The rent from the tramway company amounts to £5,923, and the amount it paid for current at 1d. per unit during the year ended March last was £4,000. Private consumers are supplied at from 2d. to 3¾d. per unit, according to the amount required, and power is being supplied to manufacturers at from '95d. to 1¼d. per unit. The sum repaid on the electricity loans is £30,000, reducing the amount outstanding to £68,000. An estimate of what it would cost to convert the business into a paying concern is £30,000, and rather than boldly face this expenditure the Council, at its meeting in September, will discuss the advisability of selling the works.

Fife.—A new contract has been arranged with Messrs. R. Bruce & Son, contractors, Edinburgh, for the construction of an electric power station at Crombie, near the new naval dockyard at Rosyth. This power station will have its site near the western extremity of the Admiralty's ground, and will be used for the purposes of the Naval Explosives Works. No details are yet made public of the installation, but it is understood that it will be on a comprehensive scale.

At the new power station for the large dock at Methil, on the Firth of Forth, the work of installation is being carried through by the North British Railway Co. themselves. Practically, the station is now equipped and ready for duty.

Greenock.—The negotiations which have proceeded for some considerable time now for the purpose of bringing Port Glasgow within the Greenock electric supply area proper have fallen through. This emerged at the last meeting of the Greenock T.C., at which, it was explained by Mr. J. W. Bailey, the convener of the Electricity Committee, that Port Glasgow Corporation had not only refused to give Greenock T.C. the guarantee asked for, but had refused to meet and discuss the propositions. All Greenock asked was that it should have security for its capital in giving a supply to the six power users, but in doing so it did not intend to prevent Port Glasgow obtaining a lighting supply throughout the burgh at any time during the period of agreement. Greenock Corporation was better able to give that supply than any other authority, but should it decline to do so, it would put no obstacle in the way of any other company or authority giving the supply. Complications had really arisen through the B. of T. inserting a provision regarding the purchase of the Greenock plant, and if the Board had given an indication when first approached four months ago that such a condition would be attached to the order, Greenock might have adjusted terms with Port Glasgow before lodging the application. When the position was made clear and the matter discussed in a friendly spirit he believed they would be able to come to an agreement which would ensure to Port Glasgow T.C. that it would not be prevented from obtaining a lighting supply throughout the burgh because of Greenock's supplying the six large power users. The minutes were subsequently approved.

Hindley.—The B. of T. has informed the U.D.C. who had asked for a further extension of time of the Provisional Order, that the grounds submitted for further extension would not justify the Board in continuing the order.

Honiton.—In regard to our note under this heading, last week, we are asked to state that the Honiton and District E.S. Co. have obtained the contract to install electric light and to supply electricity at the workhouse—not the Devon E.L. Co.

Hoylake.—The condition of the U.D.C.'s electrical undertaking was reported upon at a recent meeting, when Mr. English, in moving the minutes of the Electric Supply Committee, said the profits of the past year amounted to £400, although he had only anticipated a net profit of £250. The amount would go to the capital account of the undertaking, which now stood at £2,600, and in a few years £4,000 would be reached.

Leek.—The U.D.C. has decided, in connection with the charges for electricity, that a flat rate of 4½d. per unit be offered for factory lighting, in future, as an alternative to the maximum demand rate. It is thought that this will be an advantage to consumers in simplifying the charges, and will not make any real difference to the Committee.

Mexico.—The Compania Idroelectrica Mexicana has been founded in Mexico with a capital of 30,000,000 pesos. The falls on the River Naranjo will be used to supply power, and a station will be erected there with a capacity of 65,000 H.P. This station will cost 2,000,000 pesos to erect, and the plant will be supplied by the Siemens-Schuckert-Werke. The capital of the company has been chiefly subscribed in France.

Norwich.—On Tuesday night the serious flooding of the city owing to the recent rain, reached the Corporation electricity station, where the boiler furnaces were drowned out, and the whole of the electricity supply cut off. The position is a serious one for electricity users, and, we believe, the tramway undertaking has also suspended operations.

Nuneaton.—The T.C. has arranged to replace each year, for three years, 50 street gas lamps by electric lamps.

Peterborough.—At the meeting of the T.C. on Tuesday, the city engineer reported that an extension of the generating plant at the Corporation works, and probably of the buildings also, would in all likelihood be required to meet the increasing demand in the winter of 1913-14. The engineer was instructed to prepare alternative reports and estimates for extensions by the H.T. alternating and L.T. continuous current system.

Owing to the great floods, the Corporation electricity works have been surrounded by water, access to them being obtained only by means of planks laid on brick supports. The works lie on slightly rising ground, but cottages adjoining have had two to three feet of water in their lower rooms

Philippine Islands.—According to the local Press, a company, with a capital of about £153,000, has been formed, for the purpose of generating electric power from the Agno River for supply to the mining plants and saw mills on the river, and for the ighting of Bagnio.—*Board of Trade Journal.*

Rawtenstall.—The L.G.B. has forwarded its sanction to the borrowing of money by the Corporation for the extension of the existing engine room, a new generating set and switchboard, mains, rotary converter, transformer, &c., at the electricity works.

South Africa.—At a meeting of the Durban T.C., held on July 30th, the Electrical Committee's recommendations with regard to the amendment of the tariff for the supply of current to private residences were discussed and approved. Under the new arrangement, users can remain on the old tariff, if they prefer, or enter into an agreement to come on to the new tariff for a period of at least 12 months, after which period three months' notice has to be given if for any reason it is desired to again revert to the old tariff. Briefly, the new tariff is based on a certain number of units (at 6d. per unit) in proportion to the rateable value of the house, but not the land, as a minimum charge; and, thereafter, all units at ¾d. per unit. The object aimed at in this tariff is the encouragement of electric cooking and heating, which it is anticipated will be largely taken up. The minimum for a brick house rated at £200 is 10 units; £400, 16 units; £800, 24 units; £1,000, 26 units, and so on, up to a maximum of £1,200, with a minimum of 29 units, and all current consumed in excess of the foregoing minima will be charged at ¾d. per unit, less the usual 10 per cent. if paid for within seven days.

This tariff comes into force at the option of any consumer as from August 1st, and does away with the present cheap-rate day supply, which is controlled by a time switch. The Committee has yet to consider a tariff suitable for other consumers other than private residences, and also the question of hiring out apparatus.

Ordinances have now been passed, authorising the T.C. of Pietermaritzburg to borrow £50,000, of which £41,000 is for the purpose of extending the electric supply undertaking within the borough, and £9,000 for the erection of a bridge over the Umsindusi River; also authorising the T.C. of Ladysmith to borrow £25,000, of which £12,000 is to be spent on improving the electric lighting and power system of the town.

Swanage.—The B. of T. has deferred the question of revoking the E.L. Order, 1906, for three months from June 29th. Dr. Purves, of Exeter, has the electricity scheme in hand.

Tasmania.—An offer has been made by the Hydro-Electric Power and Metallurgical Co., which is erecting its station at the Great Lake in the centre of Tasmania, to the Hobart City Council to supply electric power for the tramways, which the Council is about to purchase, at ¾d. per unit up to 476 H.P., and ½d. per unit for all above that amount. The offer is for a 10-years' contract, and may be renewed for 10 years at the flat rate of a ½d., the Council to have power for all municipal purposes at the same rate. The company would also lease the present power station and plant, using the building as a transforming station and the plant as a stand-by, and paying £750 a year rent. The company would take over without the tramways, the Tramways Co.'s present contracts for lighting and power.—*Australian Mining Standard.*

Wellingborough.—The E.L. company has offered to dispose of its undertaking to the U.D.C. for £27,000. The Council has informed the company that the price is very much in excess of what was anticipated, and the offer will not be entertained.

TRAMWAY and RAILWAY NOTES.

Argentina.—The firm of M. Herlitzka y Cia., Sociedad Para Empresas Electricas, which works with the support of the Banco Frances del Rio de la Plata and French capitalists, has secured the control of the generating stations at Bragado (Buenos Ayres), Necolhea (Buenos Ayres), San Juan and Resistencia, with the telephone network. A short time ago it founded the Compania General de Ferro-Carriles Economicos, which has acquired the narrow-gauge line from Corrientes to Caa-Caty and Mburucuya, with other extension concessions, and the tramway company in Corrientes with a 22-km. steam and electric track.—*Elektro. Zeitschrift.*

The Santa Fe municipality has been treating for the transfer of the Winby concession for electric tramways to the firm of Parcus and Co., of Buenos Ayres.

Australia.—A deputation, representing the 76 municipalities in and around Melbourne, has waited on the Premier to ask his support in introducing to Parliament a Bill for taking over and extending the Melbourne tramways, providing for cheap sectional fares, and that all municipalities should share in the profits or losses, as the case might be.

Birmingham.—Mr. Baker, the general manager of the tramways, is preparing a scheme showing the probable cost and working charges of a system of railless cars.

It is stated that the Tramways Committee contemplates introducing a service of single-deck cars on the new route along Hagley Road.

Bradford.—The receipts on the Corporation tramways for the 139 days of the present financial year have been £113,555, a decrease of £2,232, as compared with the corresponding period of the previous year.

Continental Notes.—ITALY.—The Italian Minister of Public Works has received a provincial deputation representing Rovigo, Mantua and other provinces, when evidence was put before him illustrating the importance of a network of tramways approximating 200 KW., and the urgent necessity of putting such work in hand without delay. This will be the largest network in Italy. Discussing the preliminary financial questions, the Minister assured the deputation of the sympathy of the Government in a matter of such apparent necessity, which would so greatly facilitate intercommunication between the numerous provinces concerned. The deputation left the Minister with the firm impression that it would be possible to put the work in hand at an early date.

A large network of tramways is now being advocated and studied for the district of Reggio. Representations have been made to the Government concerning the construction of five important lines running into the various suburbs. Engineers from Rome are working on the project.

GERMANY.—The Ruhr-Lippe Light Railway Co. is considering the question of converting its line between Arnsberg and Solst to electric traction.

Dublin.—The *Freeman's Journal* has a quarrel with the Dublin United Tramways Co. on the question of fares. The complaint is that three separate 1d. fares will carry the passenger over a greater distance than one 4d. through fare on the same route; also that 3d., 4d. and 5d. fares are made up of overlapping 1d. fares. The *Journal* asks if, when the Dublin Corporation insisted on minimum 1d. stages, it was intended that these stages should overlap, and through passengers pay twice over for portions of the journey. The question of half fares for children is also brought forward.

Glasgow.—At its last meeting, the Tramways Committee had a number of topics under discussion. Succinctly the findings were: That the general manager should continue with the experiments in the welding of rail joints; that more motor meters, such as are at present in use on the cars, should be purchased; and that the proposal for the erection of cottage dwellings for employés upon the vacant ground at Newlands depôt be continued meantime.

Oswaldtwistle.—With reference to the question of the rating of tramways, upon which there was an appeal in the law courts pending, it was stated by Mr. A. Hargreaves at the monthly meeting of the Oswaldtwistle U.D.C. that unless the decision was reversed the Council would only receive a quarter instead of the full rate from the Accrington and Blackburn Corporations. The Blackburn authority, he was glad to notice, had this year sent its full rate, but he could not say the same of Accrington. The latter had deducted three-quarters of the rates, and he thought it would only have been courteous on its part to have refrained from making any deduction until the question was definitely settled. The Oswaldtwistle Council allowed the Accrington Corporation to construct tramways in Oswaldtwistle on the understanding that Oswaldtwistle received the full rateable value. If that had not been understood, Oswaldtwistle would have gone in for a larger share of compensation from Accrington. In Mr. Hargreave's opinion the Accrington Council ought to have sent the full amount or a note explaining why it did not.

Keighley.—A statement submitted last week to the Corporation reveals the fact that, whilst the working of the year ended March 31st last, shows a profit of over £1,100 in connection with the electric cars, there has been a loss of £2,437 on the motor-'buses running in connection with the department. The tramways receipts were £9,839, as compared with £9,616 in the previous year, and the 'bus receipts were £5,628, as against £4,935. In moving the adoption of the report, Mr. Smith said he did not think such a loss would be tolerated, but for the fact that the 'buses were feeders of the tramways. Alderman King (chairman of the Finance Committee) said he did not think the 'buses were feeders to an extent sufficient to justify a loss of £50 a week, and he intended to move, at the next meeting, that the 'bus service be discontinued. The report was adopted.

The Tramways Committee has been authorised by the Corporation to prepare a scheme of railless traction between the existing terminus at Ingrow and the junction of Haworth Road and Hebden Road, and to obtain tenders for the necessary equipment. This is in furtherance of a general idea of extension of the railless trolley system, which has found in Keighley, as elsewhere in the West Riding, considerable favour.

Ramsbottom.—In connection with the railless traction scheme the members of the Council have had an interview with Mr. J. B. Hamilton, the manager of the Leeds tramway system, and it is understood that the latter has been empowered to draw up specifications at an early date.

West Yorkshire Tramway Developments.—On all hands the network of electric tramways in the West Riding of Yorkshire is constantly becoming more intricate by reason of the frequent extensions of their respective systems by the local authorities of the crowded cities and towns of this industrial locality. At the present moment, Leeds, Bradford, Halifax, Huddersfield, Brighouse and others are concerned in various extensions of their routes. The latest project is a proposed arrangement between the Corporations of Bradford, Huddersfield and Halifax so to extend existing lines as to permit of through tramway service between Bradford and Huddersfield, *via* Brighouse, and also a connection between those towns and Halifax, only broken by reason of the smaller gauge of the Halifax lines, an obstacle which, of course, could, if necessary, be overcome by means of a third rail along the narrow-gauge tracks, or even by means of the extensible axle system which is already established, on the through Bradford to Leeds route. The Bradford authorities have decided to extend from Wyke to Bailiff Bridge, Halifax has 726 yd. of track between Bailiff Bridge and Brighouse, and Huddersfield proposes to apply for powers to construct a line to Brighouse *via* Raistrick. Halifax, realising that if Huddersfield carries out its intention, it might have to relinquish the Bailiff Bridge line to the Huddersfield and Bradford authorities on the ground of public interest, and also that, at any rate, much of the present traffic between Brighouse and Halifax would be diverted from that route, has decided to apply for powers to construct lines from Salterhebble, along Elland Wood Bottom to Elland, and from the present Brighouse terminus to Raistrick. These proposals have the approval of the Brighouse and Elland authorities, and therefore there seems to be no likelihood of opposition.

TELEGRAPH and TELEPHONE NOTES.

Australia.—According to a recent statement of the Postmaster-General, wireless stations are now open at Melbourne, Hobart, Adelaide, Brisbane and near Port Moresby. The Government intends to construct 10 other stations this year along the coast, and eventually the whole coast line will be linked up and connected with the Imperial system. It is reported by the *Australian Mining Standard* that negotiations are in progress between the wireless companies and the Government, with a view to the settlement of the disputes now before the High Court in respect of infringement of patent rights.

Wireless telegraphy is to be adopted for military purposes by the Australian Defence authorities.

Falkland Isles.—The Falkland Islands are to have a wireless telegraph station capable of communicating with Buenos Ayres and Monte Video.

Japan.—The connecting work on the cables between Fusan and Shimonoseki, and between Seoul and Fusan, is now completed, and a through telegraph service between Shimonoseki and Seoul has been opened.

Paris-Odessa.—It is reported from Odessa that apparatus has been installed there for correcting chronometers by the Paris Observatory through the wireless telegraph station on the Eiffel Tower, Paris, over a distance of 3,000 km.

Telegraphic Breakdowns.—During the past week, in addition to the fire at the G.P.O., London, reported elsewhere in this issue, the telegraph department has had to contend with serious troubles in the provinces due to the wet weather. A landslide in Norfolk isolated Norwich, Yarmouth and Lowestoft, on Monday evening, and the northern wires were working badly. Communication with Germany was also affected by the landslide.

Venezuela.—The Government intends to install wireless telegraph stations at La Guayra, Puerto Cabello, Maracaibo and Cumana. Provision for this will be made in the 1912-13 and succeeding Budgets.

Wireless Telegraphy from Aeroplanes.—The wireless apparatus designed for military aeroplanes by the Société Radio-Electricité weighs only 66 lb. and absorbs less than ½ H.P., with an antenna of 82 ft. Excellent results have been obtained up to a distance of over 50 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberaman.—September 11th. Electrical fittings, for the Powell Duffryn Steam Coal Co., Ltd., 101, Leadenhall Street, London, E.C. Stores Manager, Aberaman, near Aberdare (Form No. 26).

Australia.—New South Wales.—September 25th. Trunk line switchboard, for the P.M.G.'s department. See "Official Notices" August 23rd.

October 2nd.—N.S.W. Government Railways. Six 1,000-kw. sub-station units to specification No. 357. Specification (10s.) from Electrical Engineer's Office, 61, Hunter Street, Sydney.

October 16th.—N.S.W. Government Railways. Two 5-ton electrically-driven travelling cranes, for the Randwick workshops. Specification No. 365 (5s.). Electrical Engineer's Office, as above.

South Australia.—October 1st. Telephone switchboards at Unley, Adelaide, for the Postmaster-General's department. See "Official Notices" August 23rd.

October 1st.—Telephone switchboards at Norwood, for the P.M.G.'s department. See "Official Notices" August 23rd.

October 22nd.—Telephone switchboard at Port Adelaide, for the P.M.G.'s Department. See "Official Notices" to-day.

October 23rd.—100 common-battery table telephones, for the P.M G.'s Department, See "Official Notices" to-day.

Victoria.—September 3rd.—Six 60-K.V.A. transformers, for the Melbourne City Council. See "Official Notices" August 16th.

September 17th.—One fuel economiser, for the Melbourne Corporation electricity works.

October 2nd.—Two vertical sets of electrically-driven rotary pumps, for the Melbourne City Council. See "Official Notices" August 16th.

October 22nd. Fourteen sections of common-battery multiple switchboard, for the P.M.G.'s department. See "Official Notices" to-day.

Western Australia.—November 5th. Telephone switchboards to Stores Schedules 222 and 223, for the P.M.G.'s department, Perth. See "Official Notices" to-day.

Austria.—Vienna.—November 30th. Plans are required for the erection and operation of an electrically-worked municipal central clock installation. Particulars, Magistratabteilung V, Vienna.

Bedwas.—September 5th. Electrical goods for a year for the Bedwas Navigation Colliery Co., Ltd. (Form 4). The Secretary.

Bulgaria.—September 9th. The District Administration of Finances, in Sofia, is inviting tenders for the supply of a number of electrically-operated cranes for the Bulgarian State Railways.

Bury.—August 31st. Electric light installation for the Infirmary. Specification 20s. (returnable) from the Secretary at the Infirmary, Walmersley Road.

Costa Rica.—December 9th. Tenders are invited for the building and working of an electric tramway between Alajuela and Grecia, a distance of 18,100 m. Particulars from the Secretaria de Fomento, San José.

Felixstowe and Walton.—September 5th. Extensions to accumulators and balancer-booster, for the U.D.C. See "Official Notices" August 23rd.

France.—September 3rd. The French Post and Telegraph authorities in Paris (103, Rue de Grenelle) are inviting tenders for the supply of a quantity of rubber-insulated electric cables.

Glasgow.—The engineer of the electricity department (Mr. W. W. Lackie, Waterloo Street) has been instructed to obtain and submit to the departmental committee offers for the supply of 400 additional flame arc lamps.

Leeds.—September 9th. Paper-insulated cables, for one, two or three years, for the City electric lighting department. See "Official Notices" August 9th.

London.—L.C.C.—September 24th. Electric spark gaps in brick cells for sub-stations. See "Official Notices" August 23rd.

Manchester.—September 10th. One 12,000-kw. three-phase high-pressure turbo-alternator, with condensing plant, &c., water-tube boilers and superheaters, economisers and coal chutes, for the Corporation. See "Official Notices" August 9th.

Middleton.—September 11th. One 300-400-kw. steam dynamo, for the Corporation. See "Official Notices" to-day.

Newport (Mon.).—August 31st. Special track work, for the tramways, for the T.C. Mr. A. Nichols Moore, electrical engineer, Town Hall. (Returnable deposit of 10s. 6d.)

Rosario.—October 15th and September 21st. According to the *Review of the River Plate*, the Municipality is calling for tenders, until October 15th, for a second system of electric tramways, including their construction and working. Full particulars from the Municipality. Tenders for the public electric lighting will be opened on September 21st.

Torquay.—September 2nd. One 1,000-KW. single-phase turbo-alternator, condensing plant and switchgear, for the T.C. See "Official Notices" August 16th.

Warrington.—September 11th. Electrical sundries, for six months, for the B.G. Mr. A. Bottomley, clerk, Bewsey Chambers.

West Ham.—September 12th. Electrical fittings for six months, for the B.G. (Form 15). Mr. Thos. Smith, clerk, Union Road, Leytonstone, N.E.

West Hartlepool.—September 3rd. High-tension three-core paper-insulated cables and low-tension rubber cables and wiring, for the Corporation. See "Official Notices" August 23rd.

September 14th. Steam, exhaust and other pipework, for the Corporation Electricity Department. See "Official Notices" to-day.

CLOSED.

Ashton-under-Lyne.—The water-cooling tower contract mentioned last week was placed with the Davenport Engineering Co., of Bradford, not the Bradford Engineering Co., as stated by us. We understand that there is no company with the latter name.

Australia.—The New South Wales Public Works Department has ordered two electric goods lifts for the new warehouse, "Bushell's" Stores, George Street North, Sydney, from Hydraulic Engineering and Hercules, Ltd., Sydney, for £1,190.—*Australian Mining Standard.*

Glasgow.—The T.C. has approved of the acceptance of the following tenders:—

Welding rails.—Tudor Accumulator Co.
91/17 E.H.T. single-core cable.—St. Helens Cable and Rubber Co.
Three-core E.H.T. lead-covered cable.—National Conduit and Cable Co.
Traction street poles.—Stewarts & Lloyds.
Fuel for depôts.—John Kennedy & Sons, Wm. Young & Sons.

Johannesburg.—The municipality has accepted the tender of the Union Electric Co., of Johannesburg, for 20 "Union" transformers, ranging from 35 to 100 K.V.A., of the single-phase oil-cooled pattern, at a total price of £1,421.

Launceston.—The T.C. has accepted the tender of Messrs. Lord & Shand for installing the electric light at the municipal buildings, at £74 odd.

London.—Messrs. Francis Reade & Co., of Finchley, have obtained the contract for the electric lighting at Messrs. Carter, Paterson & Co.'s new depôt at Finchley, N.

Manchester.—Messrs. W. Geipel & Co. have secured the major portion of the Corporation contract for the two years' supply of time switches, for various sizes up to 100 amperes 500 volts, those for the two-rate power schemes being their latest model with oil-immersed switch.

Nuneaton.—The T.C. has accepted the tender of Messrs. Marshall, Osborne & Co. for an electrically-driven turbine pump, at £146, and that of the British Insulated and Helsby Cables, Ltd., for 600 yd. of '05 three-core cable, at £127, and 880 yd. of 7/16 three-core cable, at £120.

Portsmouth.—The Tramways Committee of the T.C. has accepted the tender of Messrs. Cammell, Laird & Co., Ltd., for steel tires for tramcars, at £1 11s. 6d. each.

Rawtenstall.—The T.C. has accepted the tender of Mr. Geo. Bullock for a multi-jet condenser and the pipework and valves, &c., required at the electricity works.

Southend-on-Sea.—The T.C. has accepted the following tenders:—

Callender's Cable and Construction Co., Ltd.—Cables for two years.
Bristol Wagon and Carriage Co., Ltd.—Four rubber-tired wheels for motor tower wagon, £134.
British Thomson-Houston Co., Ltd.—Armature for tramcar motor, £23.
Worthington Pump Co., Ltd.—Pump and motor for fountain, £25, and centrifugal pump, £62.

FORTHCOMING EVENTS.

British Association.—Wednesday, September 4th to Wednesday, September 11th inclusive. Meeting at Dundee.

North-Eastern Counties Electrical Exhibition.—Saturday, September 7th to Saturday, September 28th inclusive. At the Exhibition Hall, St. Mary's Place, Newcastle-on-Tyne.

Appointments Vacant. — Assistant engineer for the Burnley Union Workhouse, 35s.; works superintendent (£130) and charge engineer (£90), for the Corporation Electricity Works, Bridlington. See our advertisement pages to-day.

NOTES.

Inquiries.—Makers of an electrically-propelled bath chair are asked for. A correspondent asks for makers or dealers in "Atroon," and also what this substance is used for.

London Telephone Service.—A circular, entitled "How Subscribers may Help to Improve the Telephone Service," has been issued from the Controller's Office, and is reproduced below:—

Many subscribers think that the question whether telephone service is efficient or inefficient depends upon the exchange alone. This view is entirely wrong. Quality of service depends upon the joint work of exchange and subscriber, upon the degree to which the work of each of the two parties helps or hinders the other. Each of the two parties has a definite work and responsibility which the other cannot take. It is, therefore, important that subscribers should bear in mind the following points:—

1. Telephonic transmission blurs the distinctive sounds of consonants and tends to make words containing the same vowels sound alike. In passing numbers, therefore, it is necessary to speak more distinctly than in ordinary conversation. There is great risk of confusion between five and nine, and much difficulty in distinguishing between two and three. Special care in passing these numbers is, therefore, necessary.

2. Each figure in a number should be given separately, thus—"1234" should be given as "one—two—three—four" and not as "twelve hundred and thirty-four" or "one thousand two hundred and thirty-four,"

Double figures should be given thus—"2234" as "double two three four." "0" should be given as "Oh" and not as "nought"—except in the case of even thousands, when the word thousand should be used.

3. It is the duty of the operator to repeat every number passed by the subscriber, in order to give the subscriber an opportunity of correcting any misapprehension. If in any case the repetition is not clear, the operator's attention should be called to the fact. If the repetition is incorrect, the right number should be repeated very distinctly, with emphasis on the figures misunderstood.

If the operator is not sure she has taken a number correctly it is her duty to ask the subscriber to repeat the particulars. Prompt compliance with the request is of great assistance to the service.

4. To gain the operator's attention after she has taken a number, the receiver rest should be moved up and down at the rate of about one depression per second until the operator answers. The movement should cease directly an answer is received.

5. If you wish to bring any difficulty under notice ask the exchange for "Clerk in Charge." If the difficulty cannot be settled by this means, ask for the Exchange Manager.

Marked improvement in the service will inevitably result if subscribers, as a whole, act upon the foregoing suggestions.

Annual Outing.—On Thursday, August 22nd, in connection with their recreation club, a party of officials and employés of the Mexborough and Swinton Tramways Co. paid a visit to London. The party, consisting of motormen, conductors, and station staff, was accompanied by Mr. G. Priestly, engineer and manager; Senior Inspector H. J. Smith; Inspector A. Hayes; G. Durber, chief clerk; and a few local gentlemen. By the permission of Mr. E. Cross, engineer and manager of the Rotherham tramways, and Mr. A R Fearnley, of the Sheffield tramways, the party were conveyed by special through-car from the Rawmarsh depôt to the Sheffield Midland Station. Luncheon was served *en route* to London, and following a prepared programme, a tour of the Metropolis was made, and many places of interest were visited, London being seen at its best in glorious sunshine. After tea, part of the company spent the evening at music halls, whilst others visited the "White City." We are informed that it was a happy company that met again at St. Pancras at 12.35 a.m.

Electrical Fatalities.—According to reports in the daily Press, a woman and child were killed, and a second woman was seriously injured by electric shock at Fodderty Glen, near Dingwall, on Monday. An overhead electric conductor running from Raven's Rock to Dingwall short-circuited and fused, subsequently falling on the grass, through the falling of a tree branch owing to the heavy rain. An 11-year old child observing the sparking put her foot on the wire and was killed immediately, her foot and hand being burned. A woman was killed in attempting her rescue, and the girl's own mother received a bad shock in attempting to remove the wire from the earlier victims.

Educational. — UNIVERSITY OF LONDON, Goldsmith's College, New Cross, S.E.—An announcement is made in our advertisement pages to-day regarding evening courses in the various branches of engineering, &c. The session commences on September 23rd.

UNIVERSITY OF LEEDS.—Notice is given in our advertisement pages to-day regarding the departments of electrical and mechanical engineering, fuel, &c. The next session commences on October 1st.

Institution and Lecture Notes.—At the International Congress of Mathematicians at Cambridge on Monday, Sir J. J. Thomson lectured on "Multiply Charged Atoms." The lecture, which was illustrated by experiments, dealt with recent developments of the author's method of determining the chemical constitution of atoms and radicles, and the existence of groups hitherto undetected, by means of their electric charges as determined by

deflection of the path of the projected radicle in electric and magnetic forces, when such forces are applied to very small quantities of a substance placed in a highly exhausted vessel.

On Saturday Sir W. H. White delivered a lecture on the place of mathematics in engineering practice. He said that an adequate knowledge of mathematics must be possessed by every educated engineer. Some authorities now favoured special courses in "practical mathematics"; others believed that engineers should be taught by professional mathematicians, because this method must lead to broader views and greater capacity for original investigation. His experience led him to rank himself with the supporters of the latter view, and this view had now been adopted at the Imperial College of Science and Technology.

A joint excursion of the National Association of Colliery Managers and the Association of Mining Electrical Engineers took place to Loch Lomond on Saturday. About 150 took part.

The Norwich Floods.—As we go to press the following notice comes to hand from Messrs. Laurence, Scott & Co., Ltd., Gothic Works, Norwich:—"Owing to the disastrous floods, the stoppage of post and railway traffic, and the fact that our offices and works are deeply flooded, we regret that there must be an unavoidable delay in attending to all correspondence." We are quite sure that all our readers will feel sympathy with the firm, with the other electrical undertakings, and, indeed, with everybody in the city of Norwich and the Eastern Counties in their present unparalleled experiences.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. FRED TYRRELL, late chief assistant to the Ascot District Gas and Electricity Co., has been appointed commercial assistant to the Battersea Borough Council electricity department for the west district.

MR. CECIL D. FALCKE, chief engineer and manager of the Stratford-on-Avon Electricity Supply Co., Ltd., has accepted an important appointment in London. MR. JULIAN G. THAIN, chief assistant engineer, has been appointed chief engineer and manager, and takes up his new duties on the 1st prox.

General.—At St. Hilda's Church, Westcliff, Whitby, on August 21st, the marriage took place of MR. HENRY FIRTH, electrical engineer, of Whitby, and Miss S. Willis, youngest daughter of Capt. James Willis, of Crescent Avenue, Whitby.

MR. LEONARD ANDREWS, joint managing director of the Canadian British Engineering Co., Ltd., which was recently floated for the promotion of trade with Canada, is sailing for that country on the *Laurentic* to-morrow in connection with the further organising of the company. Since the objects of the company were made known in May last, the directors have been approached by a large number of British manufacturers who apparently look upon the new organisation as being a means of successfully catering for the Canadian market; but although the company have been offered a large number of other agencies, they have not entered into any agreements other than those mentioned in their prospectus, as they have been anxious to avoid taking up any agencies until they are satisfied that they can handle them with credit to themselves and their principals. One of the objects of Mr. Andrews's coming visit to Canada is to ascertain what are the particular products of British engineering works for which there is the greatest demand in Canada, the company's intention being to concentrate their efforts in the first instance principally upon these lines. They have been glad to learn from British manufacturers that they are, in practically all cases, prepared to make any modifications to their standard designs that the company advise them are genuinely necessary in order to meet the requirements of the Canadian market, and many of the principals of British firms have assured the company that they will be prepared themselves to visit Canada to acquaint themselves better with the conditions there, and assist the company to introduce their manufactures, immediately they receive an assurance that the demand for their particular products is sufficient to justify this step. During Mr. Andrews's absence in Canada the English end of the business will be under the direct management of his colleague, Mr. Reginald Porter, who has for some years been a co-director in the Key Engineering Co., and has now joined the board of the Canadian British Engineering Co.

The marriage took place in London last Saturday week of MR. C. W. CROSBIE to Miss Margaret Hearn, a well-known Northampton singer. Mr. Crosbie was with the British Westinghouse Electric and Manufacturing Co., Ltd., for 10 years down to October last, when he joined Messrs. Ferranti, Ltd., as deputy sales manager in the meter sales department. Upon Mr. Reisch's resignation in February last, Mr. Crosbie took over the representation of the South of England for meters and electric cooking and heating apparatus.

MR. H. PERKINS, of Messrs. A. Emanuel & Sons, Ltd., who has represented the firm for some years in the Midlands and Eastern Counties, has been appointed their south coast representative.

Obituary.—The death occurred at Brayford, Oxford Road, Moseley, Birmingham, on August 20th, of MR. EDWARD D. PRIDEAUX, electric fittings manufacturer, of Birmingham. Deceased was 63 years of age.

NEW COMPANIES REGISTERED.

Walton & Clough, Ltd. (123,815).—This company was registered on August 17th, with a capital of £8,000 in £1 shares (5,000 5 per cent. preference), to take over the business of electrical, mechanical, mining and general engineers, carried on by C. C. F. Walton and C. H. Clough, at Horton Works, Beckside Road, Bradford, as Walton & Clough. The subscribers (with 50 shares each) are:—C. C. F. Walton, Moresby, Whitehaven, engineer; C. H. Clough, Stanwix, Guiseley, engineer. Private company. The number of directors is not to be less than two or more than five; the first are C. C. F. Walton and C. H. Clough, each of whom may retain office while holding 75 per cent. of the shares allotted to him under purchase agreement; remuneration as fixed by the company. Solicitor, H. Hammond, 35, Hustlergate, Bradford. Registered by Gordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

Electro-Osmose Syndicate, Ltd. (123,807).—This company was registered on August 17th, with a capital of £2,300 in £1 shares, to adopt an agreement with the Gesellschaft fur Elektro-Osmose m.b H., of Frankfort-on-Main, Germany, for the working of certain British patent processes for the purification of clay. The subscribers (with one share each) are:—A. H. Howard, 10, Clifford's Inn, E.C., solicitor; A. G. Hounsome, 30, Radnor Gardens, Twickenham, clerk. Private company. Table "A" mainly applies. Secretary, V. W. Robinson, High Street Chambers, Coventry. Registered office, 53A, Barton Arcade, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

San Luis (Mexico) Tramways, Ltd.—Particulars of £200,000 debentures, created July 4th, and secured by trust deed dated July 15th, 1912, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £150,000. Property charged: The company's undertaking and property, present and future, including uncalled capital and goodwill, 2,997 shares in Compania Limitada de Tranvias en San Luis Potosi, S.A. Trustees: H. C. Waters and A. Naylor.

Church Stretton Electric Supply Co., Ltd.—Further charge dated July 24th, 1912, to secure £75 charged on freehold premises at Crossways, Church Stretton, a provisional order granted to the Church Stretton Land Co., Ltd., and certain other assets. Holder: E. Bond, 43, Thurloe Square, W.

CITY NOTES.

National Electric Construction Co., Ltd.

THE directors report that the gross profit for the year ended December, 1911, was £16,568, and deducting therefrom expenses of administration, debenture interest, &c., there remains a balance of £5,176, plus £5,156 brought forward, making a total of £10,332. From this there has to be deducted £1,550 for the debenture redemption fund, leaving a balance of £8,782, which the directors recommend be dealt with as follows:—Depreciation on free wired installations, £2,000; rolling stock, &c., Dewsbury and Ossett Tramways, £239; furniture, fittings, plant and tools, £100; consols purchased for Parliamentary deposits, £2,086; carry forward. £4,857.

The monetary conditions that have prevailed during the past two years have not altered, and the difficulty in financing tramway undertakings in this country still exists. The negotiations for the important contract abroad, to which reference has been made on previous occasions, have not yet been settled, but are in a fair way to a satisfactory conclusion. Other foreign contracts are in course of negotiation. The Bill to confirm the free wiring agreements between the company and various local authorities received the Royal Assent on the 7th inst. There was strong opposition by several local authorities, which, however, after lengthy negotiations, was withdrawn. As regards the undertakings in which the company is interested.—

The Rhondda Tramways Construction Syndicate, Ltd. (in Liquidation).—Cash distributions amounting to 72½ per cent. have been made by the liquidators. In addition to this, the N.E.C. Co. is entitled to receive approximately £20,000 in 6 per cent. cumulative preference shares, and £9,000 in fully-paid ordinary shares of the Rhondda Tramways Co., Ltd. The contract referred to in the last directors' report for extensions to the Rhondda Tramways Co. was duly carried out, and the extensions were opened for public traffic in April last. During the past 18 months the Tramway Co. has suffered heavily from, first, a local miners' strike, then the general miners' strike, and, finally, a strike of the company's own employés, which lasted about a month, the men eventually returning to their duties on the company's old terms. The receipts since the resumption of work have been quite satisfactory, indicating that given freedom from labour troubles, this company's interest should be a valuable one.

Mexborough and Swinton Tramways Co.—The profit for 1911 permitted of a slightly higher dividend being paid than for 1910.

The recent miners' strike has prejudicially affected the traffic receipts, but it is hoped the loss will be made up during the remaining portion of the year.

Musselburgh and District Electric Light and Traction Co., Ltd.—The profit was below that for 1910, due to a decrease in the traffic revenue and boiler troubles, which, owing to the condition of the water, increased the expenses. Condensing plant has now, however, been installed, with the result that the works costs for some months past have shown a considerable decrease.

Torquay Tramways Co., Ltd.—The progress here was eminently satisfactory. The traffic revenue for 1911 was £22,635, as compared with £16,401 for 1910, and the profit earned enabled a first dividend of 1½ per cent. to be distributed on the ordinary shares of the company. The receipts to date this year show a further improvement.

Dewsbury and Ossett Tramways.—The profit, after providing for the sinking fund and interest payments to the local authorities, amounted to £1,033, as compared with £261 for 1910. There is a satisfactory increase both in receipts and profits from January 1st, 1912, to date.

Town Lighting Installations.—At Bo'ness the gross profits showed an increase of £993 and at Carnarvon £145, as compared with 1910 accounts, and in both cases the results were adversely affected by the coal strike, and in the case of Bo'ness also by a serious water famine in the summer.

During the year under review, Dr. G. T. Moody retired from the board, and Mr. W. B. Cownie, who for many years acted as general manager and secretary of the company, was elected a director in his stead, and was appointed managing director from January 1st, 1912.

The annual meeting was held on Tuesday at the offices, 3, Laurence Pountney Hill, E.C., Mr. L. B. Schlesinger presiding.

The Chairman, in moving the adoption of the above report, said they would remember that at the last meeting he referred again to a contract for the construction of an electric railway on the Continent, negotiations for which had been in hand for some considerable time. It then looked as if those negotiations were likely to be brought to a successful issue at an early date, as he was in a position to inform that all the local authorities—some 30 in number—had settled their differences, and had signed a petition to the Government to authorise the formation of a joint board, or some such authority, to carry out the scheme. The Government, however, had taken much longer to deal with the business than was anticipated by any of the parties concerned, but the position of the matter now was that the Government, after numerous meetings with the representatives of the local authorities, had drafted a concession which would meet their requirements, and submitted it to the authorities for their consideration. The company had points to raise on the draft, and the local authorities also had a number of points, and progress was again delayed while the representatives of the numerous authorities came into line. Eventually the representatives had a further meeting with the Government to discuss their amendments to the draft, and to put forward the points raised by the company. They had now been informed that an agreement had been arrived at, but that the completion would in all probability be delayed until after the holidays. They had had to exercise great patience over this business, but at the same time it was encouraging to the directors to know that the many points raised in connection with the proposition had all been gradually disposed of, and that progress towards completion had from all accounts been sure, although slow. They would remember that he stated that the initial contract would run into about £150,000, but that before the work was finished it was probable that extensions would have to be dealt with, and that the final scheme might reach the figure that was first discussed. That was important from their point of view, as when the scheme went through it would be the first of its kind in that country, and if successful—and they had every reason to believe it would be—there should be a good field there for future work. In addition to that proposition they had been closely in touch with other businesses abroad, and as a matter of fact their chief engineer left only a fortnight ago with the representative of an engineer of the highest standing to investigate and report on a proposition for which an option had been secured, and from all accounts it was a business which should be taken up. They had already sounded the representative of a strong financial group in the City with regard to the business, and they were sanguine that, if the report was right, the finance would be arranged, and the contract, which would run into about £250,000, or thereabouts, would come to their company. They had found it impossible to arrange the finance for new schemes in this country, although they had a couple of tramway propositions which they were confident would be profitable to those who would deal with the finance. They were still hopeful of getting them through, but there had been for some years past a great prejudice against the financing of home tramways, and that prejudice still existed. During the year they had carried out the construction of the extensions to the Rhondda tramways, which were opened for public traffic last April. Proceeding to deal with the various undertakings in which the company was interested, he said that, taking first the Rhondda tramways, the gross receipts for 1911 were not so favourable as those for the previous year. The decrease, however, was solely attributable to the Cambrian Combine strike, which lasted some 10½ months, the men only returning to work in October. The profits, however, after putting £2,000 to reserve and renewals fund and providing £2,000 for the redemption of debentures, enabled the full 6 per cent. dividend on the preference shares to be paid from the date of issue. The traffic receipts however, from January 1st this year to the beginning of March showed a large increase over those for the corresponding period of 1911, but owing to the general miners' strike the increase was turned into a decrease. However, with that strike over, and with the extensions opened, they would soon have regained the lost ground; but, unfortunately, the company's employés went on strike, which resulted in the closing down of the system for about a month. In the end, the men went back on the old terms, and the undertaking was now feeling the effects of normal times and of the extensions, and a considerable portion of the loss entailed by the strikes had been recovered, and the weekly traffic receipts continued to show good increases over the corresponding weeks of last year. In the case of the Musselburgh and District Electric Light and Traction Co., notwithstanding the miners' strike, which necessitated a considerable curtailment of the service, and the dreadful weather experienced, the traffic receipts showed a decrease of only £911. The traffic revenue of the Mexborough and Swinton Tramways Co. again showed an increase over that of the previous year, the revenue being £17,198, against £16,523 for 1910, £15,630 for 1909 and £12,712 for 1908, and until the commencement of the coal strike the receipts this year were in excess of those for the corresponding period of last year. The coal strike, of course, affected the drawings considerably, but the deficit might be made up by the end of the year. The results of the working of the Torquay Tramways Co. for 1911 were very gratifying. The gross receipts were £22,947 compared with £16,569 for 1910, and working expenses, including directors' and trustees' fees, amounted to 62 per cent. of the revenue as compared with 83 per cent. for 1910. That substantial reduction in expenses reflected great credit on the management, bearing in mind that for the first three months the surface contact system was working, with its heavy maintenance expenditure, and that the extension to Paignton, which was proving so profitable, was not opened until July 17th. The receipts from January 1st this year to date showed an increase of £4,640 over those of the corresponding period last year, and under ordinary summer conditions there was no doubt that the increase would have been more marked. In the case of Dewsbury and Ossett Tramways the profit, after providing for the sinking fund and interest payments to the local authorities, amounted to £1,033 compared with £261 for 1910 and with a loss of £829 for 1909. From January 1st to date there was a substantial increase both in receipts and estimated profit over the corresponding period of last year. The Bo'ness and Carnarvon electricity undertakings had made further progress last year. In the case of Bo'ness the gross profit showed an increase of £455, as compared with the previous year, and in the case of Carnarvon an increase of £229. Turning to the accounts, the profit and loss account showed a profit of £5,176, as compared with £1,028, and adding to this £5,156, the balance brought forward from 1910, there was a total of £10,332, from which had to be deducted £1,550 for the redemption of debentures, leaving £8,782, the disposal of which was dealt with in the report. On the credit side of the balance-sheet free-wired installations stood at £23,766, compared with £25,771, the decrease being represented by the addition to the depreciation account of £2,000. Contracts in course of completion amounted to £8,120, compared with £4,644. The expenditure to date on the Parliamentary Bill *re* free wiring was £352. The Bill received Royal Assent on the 7th inst. To their surprise they met with considerable opposition from the local authorities, and to overcome it they had to make substantial concessions to those authorities who wished to purchase their installations outright. The agreements which they asked to be confirmed had been entered into with the local authorities, in most cases at the local authorities request, and the company had expended its capital in good faith, yet when a decision was given in Court, which practically upset the agreements, they had a number of local authorities seeking to evade their moral obligations and endeavouring to secure their capital expenditure practically for nothing. They took up a position which he was sure no business man would ever of dreamed of taking, and their action confirmed the opinion they had held now for some considerable time, that one should deal with local authorities in this country as little as possible, and when one was obliged to do so, then more than ordinary precaution should be taken to protect one's interests, because if there was a loop-hole it would be taken advantage of.

Mr. J. Carr Saunders seconded the motion, which was adopted without discussion.

Consolidated Gas, Electric Light and Power Co., of Baltimore.—The directors have declared a dividend on the common shares of 1½ per cent., or at the rate of 5 per cent. per annum, for the quarter to September 30th, and on the preferred shares 3 per cent. for the half-year to September 30th.

Ascot District Gas and Electricity Co.—The directors have declared an interim dividend at the rate of 5½ per cent. per annum (5s. 6d. per share), less income-tax, on the ordinary shares for the past half-year.

Belgium.—La Société Belge pour la Fabrication des Cables et Fils Electriques, of Brussels, is increasing its capital to £80,000.

Mackay Companies.—The directors have declared the usual quarterly dividend at the rate of 5 per cent. per annum on the common shares.

Bank Rate.—The Bank Rate was yesterday raised from 3 to 4 per cent.

British Continental Electricity Co., Ltd.

THE directors' report for the year 1911-12 states that during the year 216 new installations were connected, while the number of lamps added during this period, calculated on the usual basis of 8-C.P. (carbon), has been 1,307 (motors calculated in equivalent lamps). After writing off £165 depreciation at the usual rates in respect of furniture, tools, meters, &c., and £180 depreciation of plant and stock, the balance standing to the credit of revenue account, including the amount brought over from last year, is £3,076. This the directors propose shall be appropriated as follows:—Dividend of 5½ per cent. on the 5½ per cent. cumulative preference shares for the year ended April 30th, 1909, £550; addition to the reserve fund of £400; leaving to be carried forward £2,126. The directors hope to be in a position to make a statement at the general meeting with reference to the negotiations now proceeding with a view to satisfying the arrears of the preference dividends by the issue of income debentures, and, should this scheme be approved by the preference shareholders, the directors will recommend the declaration of the whole of the dividends in arrear up to the end of the past financial year. After prolonged negotiations the arbitration referred to in the last report has been settled to the satisfaction of the directors on terms which are already proving advantageous to the company in the reduction of working expenses. £553 has been spent on capital account during the year. The annual meeting is to be held at 82, Victoria Street S.W., to-day, August 30th.

Blackpool and Fleetwood Tramroad Co.

THE general meeting was held at Fleetwood on August 23rd. MR. GEO. RICHARDSON, the chairman, said that the receipts and profits were a record. The majority of carrying companies had suffered owing to the coal strike, but this did not affect their company. The directors, fearing an early strike of miners, ordered a special supply of coal to be stored for emergency, with the result that they had not had to purchase at fancy prices. The coal contract ran out in December. They had an increase in the wages bill, like other companies, and materials had gone up in price. These accounted for the increase in expenditure for the half-year against the same period last year. The receipts were £756 more than in the corresponding half of last year, whilst the expenditure had only increased by £508.

Following the adoption of the report, several questions were asked. Mrs. Needham raised the question of economy, and Mr. Greenwood said Mr. Cameron worked the service more economically and with better results than other tramways in the country. Mrs. Needham persisted in her criticisms, causing the chairman to observe, "Certainly we will not hand over the management of this company to any person who comes and makes charges against our manager in the way you have done."

The CHAIRMAN moved that out of £6,574 standing to net revenue account, a dividend be declared for the half-year at the rate of 4 per cent., which would absorb £3,000, that £3,000 be written off to depreciation reserve, £500 to general reserve, and the balance of £1,074 carried forward.

MR. GREENWOOD seconded, and said the company's investments consisted of £10,400 of 4 per cent. preference L. and Y. Railway Co. stock.

This was carried.

Swiss Electrical Companies.

Escher, Wyss & Co., of Zurich, whose ordinary shares are held by the Felten & Guilleaume Co., report a considerable increase in the turnover in 1911-12. The company was reconstructed during the year, and the profit and loss accounts balance, this comparing with a loss of £5,000 in 1910-11.

The Watt, A.G. für Elektrische Unternehmungen, of Glarus, which is associated with the Zurich Bank for Electrical Enterprises, reports that the supply works in which the company is interested, experienced a satisfactory development in 1911-12. As net profits, the accounts show the sum of £23,300, as compared with £31,000 in 1910-11, and a dividend of 6½ per cent. is proposed on the paid-up capital of £280,000, this contrasting with 6 per cent. in the preceding year.

The net profits realised by the *Compagnie de l'Electricité et Mécanique, of Geneva*, amounted to £3,290 in 1911-12, as compared with £6,650 in the preceding year. After placing £3,000 to the depreciation fund, as in 1910-11, the balance has been carried forward. This result contrasts with the distribution of 4 per cent. on the priority shares in 1910-11. The report of the directors states that the situation was unfavourably affected by the low prices caused by keen competition during the year, and by the high interest payable on the bank debt.

The accounts of the *Bank für Elektrische Unternehmungen, of Zurich*, the Swiss investment and financing campany which is associated with the Berlin A.E.G., show a profit-balance of £265,000 for the year ended June 30th, 1912, this amount comparing with £259,000 in the preceding 12 months. It is proposed to pay a dividend of 10 per cent. on the share capital of £2,400,000, being the same rate as in each of the four previous years. The extension of the bank's business renders it necessary for additional capital to be raised, and the directors, therefore, recommend an increase to £3,000,000 by the issue of 15,000 new £40 shares, which will be taken over by a banking syndicate at the price of 150 per cent. Of the total issue 10,000 shares will be offered to existing shareholders, whilst the remaining 5,000 will be held by the syndicate for some years. The loan capital of the Zurich Bank already amounts to £2,680,000, an augmentation of £600,000 having been carried into effect last February.

The report of *Brown, Boveri & Co., of Baden*, for 1911-12, states that the conditions of manufacturing decidedly improved, and the orders for all departments were uniform throughout the year. Sale prices further declined in the first six months, although the efforts made for general increases in prices in the final months should, at most, afford compensation for the greater cost of raw materials. On the other hand, the endeavours put forth to improve manufacturing methods had led to an increase in the production without extending the plant and without incurring a considerable advance in working expenses. The company received much larger orders from mines and ironworks, and some important crane installations were carried out. As far as the operation of electric railways is concerned, it is mentioned that several large works were in course of execution. These included six locomotives of 2,500 H.P. for the Lotschberg Railway and eight locomotives for the Rhatian Railway. Nevertheless, the report states that the orders had hitherto not yielded the financial results which corresponded with the immense expense and labour incurred. The works of the Alioth Electricity Co. at Munchenstein are to be taken over by Brown, Boveri & Co. at the end of December, so as to introduce uniformity in manufacturing, and the former will then merely be continued as a "trust" company. After allocating £22,000 to depreciation, as against £21,000 in 1910-11, the accounts indicate net profits and balance forward of £97,000, as compared with £92,000 in the previous year on a share capital of £1,120,000. It is intended to pay a dividend of 7 per cent., this being the same rate as in 1910-11.

Prospectus.—*The Vacuum Electric and Gas Heating Appliances, Ltd.*—A company with this title has this week been offering to the public £65,000 in £1 shares, out of a total issue of £80,000, the difference being part of the payment to be made for the purchase consideration. The company has been formed "more particularly" to acquire certain inventions and patent rights belonging to the patentee, Mr. John Mann, trading as the Vacuum Electric and Gas Heating Co. (of Kilburn) "which has been carried on for experimental purposes in perfecting various appliances for electric and gas heating." The *provisional* patent rights comprise the following:—No. 12,367 of 1912 for vacuum electric water heater; No. 26,485 of 1911 for electric flash boiler heater; No. 27,332 of 1911 for gas flash boiler heater; and No. 11,849 of 1912 for electric flash boiler heater. We tried to obtain copies of the first three of these specifications as they are stated to have been filed, but are informed at the Patent Office that they are "not yet printed." In regard to the fourth, the specification is not yet filed. Before entering into an examination of the technical objects of the company, let it be remarked that Mr. John Mann, the patentee and vendor, is also the secretary of the company, and he is to receive, for the sale of the above-mentioned inventions, patent rights, &c., £30,000, payable as to £15,000 in cash (£2,500 immediately and £12,500 in three months) and the balance in shares. The T.O.R. Syndicate, Ltd., pays the expenses of promotion and underwrites 5,000 shares in consideration of £5,000 in cash payable by the company. Mr. John Mann is also under agreement to act for the company as works manager for five years. He is described as "a first-class marine engineer," and "a practical engineer and electrician of high standing."

In the absence of technical details of the inventions for which so high a price is asked, we are compelled to confine our comments to a consideration of what has already been done and what is physically possible in heating water

We have no hesitation in saying that electric water heaters can be obtained which have an efficiency of more than 90 per cent., and that no useful object would be served by striving after a material reduction in the loss of heat, for even at the lowest current rates for electrical energy the cost of heating water on a large scale by this means is prohibitive. Further, there are various excellent and thoroughly practical designs of electric water heaters already on the market; the patentee therefore cannot hope to escape severe competition, still less to establish a monopoly. Lastly, owing to the cost of energy, the large currents required, and the necessity of a separate meter, the outlook for heating water by electricity is with rare exceptions most discouraging, and this applies particularly to rapid heaters and flash boilers. Even the most enthusiastic advocates of electricity admit that water heating by its means is a costly luxury, and the demand for electric boilers is very small. As for the apparatus itself, although the information available is most meagre, we must point out that heating with coils is the obvious and customary method, and that the feature for which novelty appears to be claimed—the use of a vacuum to prevent loss of heat—is unnecessary, and, in this case, of doubtful utility.

We conclude therefore that, while the invention may be practical and effective, its value cannot possibly be more than a small fraction of the price demanded.

Dublin and Lucan Electric Railway Co.—At the half-yearly meeting held on 22nd inst., Mr. J. W. Hill, who presided, said that the receipts were £182 better than for the corresponding half of last year, and the net reduction in expenditure was £23. The coal strike made it necessary for them to slightly curtail their morning and evening service, but though they had to pay a considerably higher price for coal, their coal bill was £15 less for the half-year due to smaller consumption owing to the revised service. Mr. J. M'Cann seconded the adoption of the report, and it was carried.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, August 28th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	per lb.	2¾d.	..
a " Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	"	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£29 10	..
a Bleaching powder	"	£5 10	..
a Bisulphide of Carbon	"	£18	..
a Borax	"	£16 10	..
a Copper Sulphate	"	£24 15	..
a Lead, Nitrate	"	£26 10	..
a " White Sugar	"	£25 10	..
a " Peroxide	"	£32	..
e Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (88/90 %)	per ton	£22 10	..
a " Chlorate	per lb.	3½d.	..
a " Perchlorate	"	4½d.	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	7½d.	..
a Shellac	per cwt.	70/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	"	£6 10	..
a " Recovered	"	£5 10	..
a " Lump	"	£5 5	..
a Soda, Caustic (white 70/72 %)	"	£10 5	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£80	..
b " Wire, in ton lots	"	£102	..
b " Sheet, in ton lots	"	£120	..
p Babbitt's metal ingots	"	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	8¼d.	¼d. dec.
c " Tube (brazed)	"	11⅛d.	⅛d. dec.
c " " (solid drawn)	"	9⅜d.	⅛d. dec.
c " Wire, basis	"	8⅜d.	⅛d. dec.
c Copper Tubes (brazed)	"	1/0¼d.	¼d. dec.
c " " (solid drawn)	"	1/1¼d.	¼d. dec.
g " Bars (best selected)	per ton	£96	..
g " Sheet	"	£ 5	..
g " Rod	"	£95	..
d " (Electrolytic) Bars	"	£82	..
d " " Sheets	"	£100	..
d " " Rods	"	£88 10s.	..
d " " H.C. Wire	per lb.	10¾d.	..
f Ebonite Rod	"	5/3	..
f " Sheet	"	4/9	..
n German Silver Wire	"	1/7	..
h Gutta-percha, fine	"	...	..
h India-rubber, Para fine	"	5/7½	1½d. inc.
i Iron Pig (Cleveland warrants)	per ton	62/10½	1/10½ inc.
l " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Pig	"	£21 10	inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£7 15	10s. dec.
e Mica (in original cases) small	per lb.	6d. to 8s.	..
e " " " medium	"	3/6 to 6/-	..
e " " " large	"	7/6 to 11/-	..
p Phosphor Bronze, plain castings	"	11d.	..
p " " rolled bars & rods	"	1/0½	..
p " " rolled strip & sheet	"	1/1	..
o Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	11d.	..
Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£213 to £215	£2 inc.
n " Wire, Nos. 1 to 16	per lb.	2/4	1d. dec.
p White Anti-friction Metals	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	"	£30 5	10s. inc.

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd
p
r W. F. Dennis & Co.

STOCKS AND SHARES.

Tuesday Evening.

Only stern necessity would compel any journalist, of course, to mention the weather, but unhappily the duty has to be faced by the writer upon financial subjects. For the incessant liquidation from overhead affected even the market in Undergrounds, and the damp—the final letter of that adjective deserves attention—atmosphere has caused the courage of Home Railway holders to ooze away until they realised their stocks in despair, piling flatness upon depression and bear sales upon their bull closing.

Rightly regarded, the weeping weather ought to prove a decided bull point for the Tubes, since obviously it drives people into their trains at the expense of 'bus travelling. Yet so closely knit are the bonds of sympathy between one market and another, and between one section of a market and its neighbour, that falls in the securities of the passenger and the trade companies' stocks have been reflected in those of the older Undergrounds. Metropolitans and Districts have both suffered to the tune of a point or more. Districts we ventured a fortnight ago to sound a warning note about, as the price appeared to be running up rather rapidly. The big interests are letting the market sag quietly, probably content to wait until conditions improve enough to re-attract public attention to the stock, when a further advance is quite on the cards. The Company's 3½ per cent. guaranteed stock has risen 1, other similar securities being put up along with the recent rise in Consols: the return is still the handsome one of nearly 4⅛ per cent. on the money.

Central Londons are unchanged; City and South London is ½ better; East London has gone back to 8½. Whatever damage has been wrought by the downpour to the crops, it can only influence the Tubes indirectly, and there is no reason for the dulness of prices other than the sympathy cited above, reinforced by hints of dearer money such as usually are heard at this season of the year.

British Electric Traction 7 per cent. Preferred stock has dwindled again, the price losing a point, and London United Tramways Preference fell ⅛, because some of the speculators closed up their purchases as the Stock Exchange settlement approached. The various Underground Electric Railways issues have been quiet, the company's shilling shares drooping a trifle with the Home Railway market.

Buying of electric supply shares has been resumed upon a quiet scale. Some of the people best qualified to know what is happening amongst the various London undertakings, are somewhat disappointed with the sluggishness of the share market, but in their impatience they overlook the fact that a rise in any kind of "illumination shares" is a rarity in August, and they do not seem to appreciate the steady advance made in the list of quotations week by week. Westminsters are 7s. 6d. higher, and St. James's put on 5s. Chelseas gained ½; the Debenture stock 1. South Metropolitan Preference are 1/16 to the good, and London Electric Preferences are the only shares in the list this week to show a fall. Much interest awaits the announcement of the County of London's interim dividend, which will be made next month, some people thinking it is likely to maintain the 6 per cent. recently inaugurated, while others put their estimates 1 per cent. lower.

To illustrate the willingness of the investor, we may mention that a large block of Debenture stock in a well-known supply company has been placed within the last few days, and the buyers found no difficulty in getting rid of part of it very quickly.

In answer to various inquiries with reference to a new metal filament mentioned in our last "Notes," we have to say that we have no more to say about it—at present.

Sinister statements are in circulation to the effect that all is far from being well in Mexico, and that the rebels are still a power in the land. These brought down prices of some of the Mexican favourites, but have not disturbed to any extent the traction and power stocks of companies operating there. Mexican Light and Power holds its substantial advance: Mexico Tramways Fives are a point higher. Vera Cruz Debenture has risen 1½. Monterey Debenture fell 1, and these constitute the only alterations on the week.

Other members of the group are inclined to ease off a shade, for which the settlement week and the apprehensions of dearer money are sufficient to account. Rio Trams shed a point, and Sao Paulo Trams lost 2, the latter being connected—probably quite erroneously—with a steep drop in Sao Paulo Railway stock, on the suggestion of German competition. Calgary Power bonds are ½ lower.

The Anglo-Argentine Tramways group is very steady, and no special importance is attached to the whisper that the Company has its eye on fresh fields for extension; presumably a concern of this kind is always open, as a matter of course, to new areas for development. Some of our home undertakings have been known to experience the same Alexandrine desire; some of their shareholders, incidentally, may have wished they had not given way to it quite so extensively.

About Telegraphs and Telephones there is little to say. The New York Stock Exchange is rather exercised in its mind over a possible cut in the dividend on American Telephone and Telegraph stock, and the price is 1 down. West India and Panama went back 1s. 3d. after its 10s. spurt of last week, but it recovered this decline, and rose another 2s. 6d. in addition. Reuters have fallen ½. The dislocation of the telegraph service caused by the fire at the G.P.O. last Saturday night caused a certain amount of delay and inconvenience in the Stock Exchange, but the general comment amongst members was one of admiration at the prompt way in which the trouble was tackled and surmounted.

National Telephone Deferred advanced 5 points upon purchases by plucky buyers. Marconis have been a dullish market, and very quiet, the reawakening of the Rubber boomlet diverting speculative attention to this quarter, which drew away those who follow financial fashion, into rubber shares, at the expense of other sections. The rubber rise has been the latest feature in the Stock Exchange, a really enormous business being transacted. Rises took place at a speed so breathless that the experienced wondered whether it could last, a question that can be answered better on the day that this journal appears than it can to-night.

In the manufacturing list, Henleys have risen 5s., and so have India-Rubber shares, while Telegraph Constructions gained 10s. British Westinghouse Preference are being picked up by a few people, the price responding with a half-crown rise. The 4 per cent. Debenture stock, it may be worth noticing, pays rather over 6½ per cent. on the money. Castner-Kellners are 1/16 better, and Babcocks lost this fraction. Other shares are quietly firm.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Aug. 27th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord. ..	10	5½	5½	9⅜— 10⅞xd	..	5 2 4
Do. 4½ % Pref.	10	4½	4½	8⅜— 9⅜xd	..	4 12 4
Do. Second 6 % Pref. ..	10	6	6	10½— 10⅝xd	..	5 11 7
Do. 4½ % Deb. Stock	Stock	4½	4½	98 —100	..	4 10 0
Brompton & Kensington, Ord...	5	10	10†	8¾— 9 xd	..	5 11 1
Do. 7 % Cum. Pref.	5	7	7	7⅜— 8⅛xd	..	4 6 2
Central Electric Supply, 4 % Guar. Deb.	100	4	4	97 —100	..	4 0 0
Charing Cross, West End & City	5	5	5	4⅜— 4⅞xd	..	5 2 7
Do. 4½ % Cum. Pref.		4½	4½	4½— 4⅝xd	..	4 17 4
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	8¾— 4½	..	5 6 0
Do. Do. 4 % Deb... ..	100	4	4	94 — 96	..	4 3 4
Chelsea, Ord.	5	5	5	4½— 5	+ ⅛	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	98 —101	+1	4 9 1
City of London, Ord.	10	7	8	16½— 18½	..	4 6 6
Do. 6 % Cum. Pref.	10	6	6	12½— 14	..	4 5 9
Do. 5 % Deb.	Stock	5	5	118 —122	..	4 2 0
Do. 4½ % Second Deb. ..	100	4½	4½	99 —102	..	4 8 3
County of London, Ord... ..	10	5	6	11⅜— 11¾	..	5 1 1
Do. 6 % Pref.	10	6	6	11⅞— 12⅜	..	4 17 0
Do. 4½ % Deb.	Stock	4½	4½	106 —108	..	4 3 4
Do. 4½ % Second Deb. ..	Stock	4½	4½	100 —103	..	4 8 3
Edmundson's, Ord.	5	Nil	Nil	1/16— 1/16	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	3— 3½	..	Nil
Do. 4½ % First Mort. Deb. ..	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	6	6	4⅜— 5⅛	..	5 14 3
Do. 5 % Cum. Pref.	5	5	5	4⅜— 5⅛	..	4 15 3
Do. 4½ % First Deb.	100	4½	4½	92 — 95	..	4 14 9
Hove	5	9	9	7½— 8	..	5 12 6
Kensington & Knightsbridge, Ord	5	9	9	7⅛— 7⅜xd	..	5 18 0
Do. 4 % Deb.	Stock	4	4	90 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb. ..	Stock	4½	4½	78 — 82	..	5 9 9
London Electric, Ord.	8	2	2½	1⅜— 1⅝	..	4 0 8
Do. 6 % Pref.	5	6	6	4⅞— 5⅜	— ⅛	5 11 7
Do. 4 % First Mort. Deb. ..	Stock	4	4	90 — 93	..	4 6 0
Metropolitan	5	5	4	3⅜— 3⅞xd	..	5 3 3
Do. 4½ % Cum. Pref.	5	4½	4½	4¼— 4⅜	..	4 17 4
Do. 4½ % First Mort. Deb. ..	Stock	4½	4½	99 —102	..	4 8 3
Do. 3½ % Mort. Deb.	Stock	3½	3½	86 — 88	..	3 19 7
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	97½— 99½	..	4 10 6
Newcastle-on-Tyne 5 % Pref., Non-Cum.	5	5	5	4⅜— 4⅞	..	5 2 7
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	101 —104	..	4 16 2
Notting Hill, 6 % Non-Cum. Pref.	10	..	6	10 — 11	..	5 9 1
Oxford	5	7½	7½	5⅞— 6⅜	..	5 13 9
St. James' and Pall Mall, Ord.	5	10	10	8½— 9	+ ⅛	5 11 1
Do. 7 % Pref.	5	7	7	6⅞— 7⅛	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	83 — 86	..	4 1 5
Smithfield Markets, Ord. ..	5	Nil	2	1⅜— 1⅝	..	..
South London, Ord.	4	5	5	3 — 3½	..	5 14 3
Do. 5 % First Mort. Deb. ..	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref...	1	7	7	1⅛— 1⅛	+ 1/16	5 12 0
Do. 4½ % First Deb. Stock ..	100	4½	4½	97 —100	..	4 10 0
Urban, Ord...	£3	5	..	2/4— 2/4	..	..
Do. 5 % Cum. Pref.	5	5	2	2½— 3	..	3 6 8
Do. 4½ % First Mort. Deb. ..	100	4½	4½	86¼— 88½	..	5 1 8
Westminster, Ord.	5	10	10	8½— 9	+ ⅜	5 11 1
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅜	..	4 3 0

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅜— 5⅞	..	5 2 2
Calcutta, Ord.	5	8½	8½	7½— 8	..	5 6 3
Do. 5 % Pref.	5	5	5	5 1/16— 5 5/16	..	4 14 1
Calgary Power, 1st Mort. Bds.	100	5	5	95½— 97½	— ½	5 2 7
Canadian Gen. El. Com. ..	$100	7	7†	114 —119	..	5 17 8
Do. 7 % Pref.	$100	7	7	120 —124	..	5 13 0
Cordoba Lt., Power and T., Ord.	1	3	3†	1 3/16— 1 5/16	..	3 4 0
Do. 5 % Deb.	100	5	..	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	92 — 94	..	6 7 8
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	81 — 84	..	5 19 1
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	99½—101½	..	4 18 6
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	1/32— 1/32	..	Nil
Do. 6 % Pref.	1	6	6	13/16— 29/32	..	8 6 0
Kaministiquia Power, 5 % G. Bs.	$500	5	5	104 —106	..	4 14 4
Madras, Ord.	5	..	..	1⅛— 2/8	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	102 —105	..	4 15 3
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	89 — 91	..	5 10 0
Mexican Lt. & Power, Common	$100	4	4	96 — 99	..	4 0 10
Do. 7 % Cum. Pref.	$100	7	7	109 —112	..	6 5 0
Do. 5 % 1st Mort. Gold Bds.	..	5	5	96¼— 98½	..	5 1 6
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	87⅛— 89½	—1	5 11 9
Montreal, Lt., H. and Power ..	$100	7	8	242 —247	..	3 4 9
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5	39 — 42	..	11 18 2
River Plate, Ord.	Stock	10	10	240 —250	..	4 0 0
Do. 6 % Non-Cum. Pref. ..	Do.	6	6	109 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	101 —108	..	4 17 1
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital ..	$100	4	5†	151 —156	..	3 4 1
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	108 —110	..	4 11 0
Do. 4½ % Per. Deb.	Stock	4½	4½	104 —106	..	4 5 0
Toronto Power, 4½ % Deb. ..	Do.	4½	4½	99½—101½	..	4 8 8
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	+1½	5 6 5
Victoria Falls Power, Pref. ..	1	Nil	11¼d.	31/32— 1 1/32	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	105½—107½	..	5 11 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7¼— 7⅝	..	5 3 3
Do. 5 % Deb. Red.	Stock	5	5	96½— 98½	..	5 1 6
American Telep. & Teleg., Cap.	$100	8	8†	148 —150	—1	5 6 8
Do. Collat. Trust	$1000	4	4	93¾— 95¾	..	4 3 9
Anglo-American Telegraph ..	Stock	8⅜	8	67¾— 69¾	..	5 7 11
Do. 6 % Pref.	Do.	6	6	113 —114	..	5 5 3
Do. Def.	Do.	80/-	80/-	26½— 26¾	..	5 13 2
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102½—104½	..	4 16 2
Chili Telephone	5	7	..	7¼— 7⅜	..	4 10 4
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	83 — 85	..	4 14 2
Cuba Telegraph	10	6	6†	9¾— 10⅜	..	5 14 3
Do. 10 % Pref.	10	10	10	16½— 17⅜	..	5 14 3
Direct Spanish Telegraph, Ord.	5	4	4†	8¼— 8⅝	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	7 — 7⅝	..	6 9 0
Direct United States Cable ..	10	4½	5	7⅜— 7⅝	..	6 7 0
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98 —100	..	4 10 0
Eastern Telegraph, Ord. Stock	Stock	7	5†	128½—131½	..	5 6 5
Do. 8½ % Pref. Stock.. ..	Do.	8½	8½	77½— 79½	..	4 8 1
Do. 4 % Mort. Deb.	Do.	4	4	99½—101½	..	3 18 10
Eastern Extension	10	7	5†	18 — 18½	..	5 3 8
Do. 4 % Deb.	Stock	4	4	98½—100½xd	..	3 19 7
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	26	4	4	97½—100½	..	3 19 7
Globe Telegraph and Trust ..	10	5⅞	6†	11 — 11½	..	5 4 4
Do. 6 % Pref.	10	6	6	12½— 13	..	4 12 4
Great Northern Telegraph ..	10	18	18	28¼— 29½	..	6 3 1
Indo-European Telegraph ..	25	18	5†	56 — 58	..	5 3 5
Mackay Companies Common ..	$100	5	5	90 — 94	..	5 6 5
Do. 4 % Cum. Pref.	$100	4	4	70 — 73	..	5 9 7
Marconi's Wireless Telegraph	1	5	20	4 3/8— 4 11/16	— 1/16	4 5 3
Do. 7 % Cum. Partic. Pref.	1	16	17	3⅞— 4⅛	— ⅛	4 2 6
Monte Video Telephone, Ord...	1	6	6	1 1/32— 1 3/32	..	5 6 8
Do. 5 % Pref.	1	5	5	1 1/16— 1 1/8	..	5 6 8
National Telephone Def. ..	Stock	6	6	152 —154	+5	..
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100 —101	..	4 9 1
Oriental Telep. and Elec. ..	1	8	8	1 23/32— 1 27/32	..	4 6 9
Do. 6 % Cum. Pref.	1	6	6	1 3/16— 1 5/32	..	4 18 5
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 9 0
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 —100	..	8 18 5
Reuter's	8	5	5†	10⅛— 10⅝	— ⅛	3 15 9
Submarine Cables Trust ..	Cert.	6	6	127 —130	..	4 12 4
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7⅞— 7⅞	..	5 6 8
Do. 5 % Cum. Pref.	5	5	5	5⅛— 5⅜	..	4 10 11
West Coast of America	2½	2½	2½	1 11/32— 1 13/32	..	3 18 5
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	10	1½	½	3½— 3⅝	+ 1/32	..
Do. 6 % Cum. 1st Pref. ..	10	6	6	10½— 10⅝	..	5 11 7
Do. 6 % Cum. 2nd Pref. ..	10	6	6	9⅝— 10⅛	..	5 17 0
Do. 5 % Debs.	100	5	5	100½—102½	..	4 17 7
Western Telegraph, Ltd. ..	10	7	6†	18 — 18½	+ ⅛	5 3 8
Do. 4 % Deb.	Stock	4	4	97 — 99	..	4 0 10
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	100 —103	..	4 7 5

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Aug. 27th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	1/16 — 5/16	..	Nil
Do. 5 % Pref.	1	5	5	4 1/16 — 4 3/16	..	6 8 1
Do. 4½ % Deb.	100	4½	4½	78 — 83	..	5 8 5
Brit. Elec. Trac., 6 % Pref.	100	..	..	11 — 13	..	..
Do. Do. Deferred	100	..	..	6 — 8	..	..
Do. Do. 6 % Cum. Pr'f.	100	..	6	89 — 92	..	6 10 5
Do. 7 % Non-Cum. Pr'f.	100	..	..	37 — 40	—1	..
Do. 5 % Perp. Deb.	100	5	5	98 —101	..	4 19 0
Do. 4½ % 2nd Deb.	100	4½	4½	80 — 84	..	5 7 2
Central London Railway, Ord.	100	8	8	74 — 76 xd	..	3 19 0
Do. Pref.	100	4	4	80 — 82 xd	..	4 17 7
Do. Def.	100	2	2	74 — 76	..	2 12 8
Do. 4 % Deb.	100	4	4	99 —101	..	3 19 3
City & South London, Ord.	100	1½	1½	34 — 35	+ ½	3 18 6
Do. 5 % Pref., 1891	100	5	5	106 —108	..	4 12 7
Do. Do. 1896	100	5	5	102 —104	..	4 16 2
Do. Do. 1901	100	5	5	102 —104	..	4 16 2
Do. Do. 1908	100	5	5	102 —104	+1	4 16 2
Do. 4 % Deb.	100	4	4	99 —101	..	3 19 3
Dublin United Trams, 6 % Pref.	10	6	6	10¾ — 11¼	..	5 2 2
Great Northern & City, Pr'f. Ord	10	Nil	..	1/16 — 2/16	..	Nil
Hastings Trams, 6 % Pref.	1	Nil	6	3/16 — 2/16	..	8 0 0
Do. 4½ % Deb.	100	4½	4½	71 — 76	..	5 18 5
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2¼ — 2½	..	4 11 0
Do. 4 % Deb.	100	4	4	75 — 80	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	81 — 83	..	6 0 6
London Elec. Railw'ys, 4 % Deb.	100	4	4	94 — 96	..	4 3 4
London United Trams, 5 % Pref.	10	Nil	..	4 3/16 — 5 1/16	— 1/16	..
Do. 4 % Deb.	100	4	4	72 — 76	..	5 5 3
Metropolitan Railway Consol.	100	1⅞	1⅞	54 3/16 — 55 1/16 xd	—1	2 19 0
Do. Surplus Lands	100	2⅜	2⅜	64 — 66 xd	..	4 3 4
Do. 3½ % Deb.	100	3½	3½	86 — 88	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	85 — 87 xd	..	4 0 6
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86 xd	..	4 1 5
Metropolitan District Ord.	100	Nil	Nil	28 1/16 — 39	—1¼	Nil
Do. 6 % Deb.	100	6	6	141 —143	..	4 4 0
Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Do. 4 % Prior Lien	100	4	4	99 —101	..	3 19 3
Do. 4½ % First Pref.	100	3¾	4½	89 — 91 xd	..	4 19 0
Do. 3½ % Gtd.	100	3½	3½	75 — 77	+1	4 11 0
Metropolitan Elec. Trams, Ord.	1	5/16	6	1 — 1 1/16	..	5 6 8
Do. Def.	1	Nil	..	3/16 — 4/16	..	Nil
Do. 5 % Pref.	1	5	5	13/16 — 15/16 xd	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	96 — 98	..	4 11 10
Do. 5 % Deb.	100	5	5	99 —102	..	4 19 0
Potteries, Ord.	1	2	..	5/16 — 7/16	..	..
Do. 5 % Pref.	1	5	5	25/32 — 27/32 xd	..	6 19 0
Do. 4½ % Deb.	100	4½	4½	87 — 90	..	5 0 0
South Metro. Trams, 6 % Pref.	1	6	..	1/16 — 1/8	..	7 7 8
Do. 4 % Deb.	100	4	4	70 — 75	..	5 6 8
Underground Elec. Railways	10	..	..	4 — 4 1/16	..	Nil
Do. "A"	1/-	..	..	3/16 — 1/8	..	..
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	1	1½†	90 — 92	..	..
Yorkshire (West Riding), Ord.	5	Nil	..	1/16 — 2/16	..	Nil
Do. 6 % Pref.	5	Nil	3	2 3/16 — 3 3/16	..	4 9 0
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 5

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½	5 1/16 — 5 3/16	..	5 2 4
Do. 2nd Pref.	5	5	5½	4 15/16 — 5 1/16	..	5 6 0
Do. 4 % Deb.	100	4	4	93½ — 95	..	4 4 3
Do. 4½ % Deb.	100	4½	4½	99½ —101½	..	4 8 8
Do. 5 % Deb.	100	5	5	101 —103	..	4 16 2
Auckland Trams, 5 % Deb.	100	5	5	102 —104	..	4 14 4
Bombay Elec. S. & Trams, Pref.	10	6	6	11 1/16 — 12	..	5 0 0
Do. 4½ % Deb.	100	4½	4½	97 — 99	..	4 10 11
Do. 5 % 2nd Deb.	100	5	5	97 — 99	..	5 1 0
Brisbane Trams Invt., Ord.	5	8	8	7 — 7½	..	5 6 8
Do. 5 % Pref.	5	5	5	4 7/16 — 5 1/16	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	100½ —103½	..	4 7 0
B. Columbia Elec. Rly., Def.	100	8	8†	140 —145	..	5 10 6
Do. Pref. Ord.	100	6	6	119 —124	..	4 16 9
Do. 5 % Pref.	100	5	5	109 —112	+1	4 9 1
Do. 4½ % 1st Mort. Deb.	40	4½	4½	99½ —102½	..	4 7 10
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	102 —104	..	4 6 7
Calcutta Trams, Ord.	5	6	7	6 1/16 — 6 3/16	..	5 5 8
Do. 5 % Pref.	5	5	5	4 15/16 — 5 1/16	..	4 16 5
Do. 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3
Cape Electric Trams	1	Nil	2½†	2/16 — 3/16	..	..
City Buenos Aires Trams (1904)	5	5	5	5½ — 5 7/16 xd	..	4 6 11
Do. 4 % Deb.	100	5	5	99 —102	..	4 18 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	95 — 99	..	5 1 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	4/16 — 5/16	..	Nil
Do. 5 % A Deb.	100	5	5	86 — 91	..	5 10 0
Do. 6 % B Deb.	100	5	3	35½ — 43½	..	6 18 0
La Plata Elec. Trms, Ord.	1	..	..	2/16 — 3/16	..	..
Do. Pref.	1	6	6	3 15/16 — 4 1/16	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6	1 — 1½	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1½	..	4 16 0
Do. 5 % Deb.	100	5	5	93 — 97	..	5 3 1
Madras Elec. Tr. (1904), Deb.	100	5	5	100 —102	..	4 18 0
Manaos Trams & Lt., 1st Deb.	100	5	5	90 — 93	..	5 7 6
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100½ —102½ xd	..	4 17 7
Mexico Trams Com.	$100	7	7	127 —130	..	5 7 8
Do. Gen. Con. 5 % Bonds	..	5	5	102 —104	+1	4 16 2
Do. 6 % Bonds	100	6	6	102½ —104½	..	5 14 10
Para Elec. Rlys. & Lt., Ord.	5	10	10	7½ — 7¾	+ 1/8	6 7 0
Do. 6 % Pref.	5	6	6	5 — 5½	..	7 0 4
Do. 5 % 1st Deb.	100	5	5	100½ —102½	+ ½	4 17 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1 1/16 — 1 1/8	..	1 18 4
Do. 5 % 1st. Deb.	100	5	5	99 —103	..	4 18 0
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 1/16 — 5 1/4	..	5 4 4
Do. 4½ % 1st Deb.	100	4½	4½	97 — 99	..	4 11 0
Rio de Janeiro Trams	$100	4½	5†	148 —151	—1	3 6 2
Do. 1st Mort. 5 % Bonds	..	5	5	103 —104	..	4 16 2
Do. 5 % Mort. Bonds	100	5	5	100 —101	+ ½	4 19 0
Sao Paulo Tram, Lt. and P.	$100	10	10†	257 —262	—2	3 16 4
Do. 5 % 1st Deb.	$500	5	5	105 —107	..	4 13 6
Singapore Trams, 5 % Deb.	100	5	5	84 — 87	..	5 15 0
Southern El. Tr. B.A., 5 % Deb.	100	5	5	96 — 98	..	5 2 0
Un. Elec. Trams Monte Video	5	6	7	5 15/16 — 6 1/16	..	5 14 3
Do. 6 % Pref.	5	6	6	4 15/16 — 5 1/16	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	100 —103	..	4 17 1
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	104 —106	..	4 4 11

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	3/16 — 5/16	..	8 0 0
Do. 6 % Pref.	1	9	6	1/16 — 3/16	..	7 7 8
Babcock & Wilcox	1	26	28	3 1/16 — 3 3/16	—1/16	4 2 10
Do. Pref.	1	6	6	1 1/16 — 1 3/16	..	3 16 10
British Aluminium, Ord.	1	..	..	1/16 — 1/16	..	..
Do. 6 % Cum. Pref.	1	..	..	3/16 — 5/16	..	..
Do. 5 % Prior Lien Debs.	100	5	5	93 — 96	..	5 4 2
Do. Deb. Stk.	100	5	5	84 — 87	..	5 15 0
B.I. & Helsby Cables	5	10	10	7 3/8 — 8 1/4	..	6 1 3
Do. Pref.	5	6	6	5 3/8 — 6 3/8	..	4 14 1
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
British Thomson-Houston, Deb.	100	4½	4½	96 — 98	..	4 11 10
British Westinghouse, Pref.	8	Nil	..	3/16 — 1/8	+ 1/8	Nil
Do. Deb.	100	4	4	58 — 61	..	6 11 2
Do. 6 % Prior Lien	100	6	6	102 —105	..	5 14 3
Browett, Lindley, Ord.	1	Nil	..	2/- —3/-	..	Nil
Do. Pref.	1	Nil	..	4/6 —5/-	..	Nil
Brush, 7 % Pref.	2	Nil	..	0 — 1/4	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	75 — 80	..	6 5 0
Do. 4½ % Deb.	100	4½	4½	52 — 57	..	7 17 10
Do. 4½ % Second Deb.	100	4½	4½	35 — 40	..	11 5 0
Callender's Cable	5	15	10†	10½ — 11	..	6 16 4
Do. Pref.	5	5	5	4 3/8 — 5 1/8	..	4 17 7
Do. Deb.	100	4½	4½	99 —101	..	4 9 1
Castner-Kellner	1	17½	20	8 1/16 — 8 1/8	+ 1/16	5 5 3
Do. Deb.	100	4½	4½	102 —105	..	4 5 9
Crompton & Co.	3	Nil	Nil	1/8 — 3/16	..	Nil
Do. Deb.	100	5	5	56 — 66	..	7 11 6
Dick, Kerr	1	5	5	3/4 — 7/8	..	5 14 3
Do. Pref.	1	6	6	1 — 1 1/8	..	5 6 8
Do. Deb.	100	4½	4½	95 — 98	..	4 10 10
Edison & Swan, A, £8 paid	5	Nil	..	1/16 — 1 3/16	..	Nil
Do. fully paid	5	Nil	..	1/16 — 2/16	..	Nil
Do. 4 % Deb.	100	4	4	64 — 68	..	5 17 8
Do. 5 % Second Deb.	100	5	5	75 — 78	..	6 8 2
Electric Construction	2	2½	3⅜	3/4 — 1	..	7 10 0
Do. Pref.	2	7	7	1 3/4 — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7 1/2 — 8	..	8 5 8
Do. Deb.	100	5	5	92 — 94	..	5 4 2
General Electric, Pref.	10	5	5	10 — 11	..	4 10 11
Do. Deb.	100	4	4	92 — 97	..	4 2 6
Henley's, Ord.	5	15	10†	12½ — 13	+ ½	5 15 5
Do. Pref.	5	4½	4½	4 3/4 — 5 1/4	..	4 7 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
India-Rubber, G. & T.	10	10	..	9½ — 10½	+ ½	..
Do. Pref.	10	5	5	9½ — 10½	..	4 17 7
Telegraph Construction	12	20	10†	33 — 35	..	6 14 5
Do. Deb.	100	4	4	97 — 99	..	4 0 10
Willans & Robinson	1	Nil	..	1/8 — 1/4	..	Nil
Do. Pref.	5	Nil	..	1/2 — 1	..	Nil
Do. Deb.	100	4	4	58 — 60	..	6 13 4

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 3 per cent., May 9th, 1912.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JULY, 1912.

THE returns of seaborne electrical business for July disclose exports amounting in value to nearly £420,000, as against £461,777 in the preceding month. In the case of the imports the value was £181,345, representing an appreciable increase over the June total of £171,032, while the re-exports, valued at £12,687, show a decided fall in value as compared with that month, when the total was £19,036.

Reference to our last returns shows that the exports are still well ahead of the first half-year's average of 1911, while the imports show a considerable falling off as compared with the same period.

The feature of the exports is the cable total of £94,201, largely contributed to by Japanese purchases, amounting to £39,000 approximately, and which resulted in Japan being our best customer during the month. Machinery, telephonic and telegraphic exports reached satisfactory levels, although the latter were somewhat eclipsed by the previous month's high total, notwithstanding the inclusion of a substantial export to British West Africa.

The import section calls for no particular comment, but it will be noted that the glow lamp imports were appreciably smaller than the exports; and, in fact, less than in the preceding month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	923	240	37	229	...	286	11,003	11	395	140	1,225	702	15,191
Germany	2,352	4,065	6	529	...	12	2,587	...	31	5	38	26	9,649
Netherlands, Java and Dutch Indies ...	331	1,929	220	11	...	128	1,130	45	2	14	9	695	4,512
Belgium	208	436	261	...	364	222	2,748	3,250	49	105	161	1,238	9,042
France and French West Africa	527	...	2,529	26	54	37	7,452	1,606	...	62	178	91	12,562
Portugal	36	132	33	10	...	6	486	...	92	30	562	135	1,522
Spain and Canary Isles	225	603	...	60	31	140	1,476	856	18	17	22	6,301	9,749
Switzerland, Italy and Austria-Hungary ...	558	185	148	...	93	150	8,184	...	84	589	347	240	10,578
Greece, Roumania, Bulgaria and Turkey ...	250	109	4	...	...	...	806	39	49	3	8,363	3,617	13,240
Channel Isles, Gibraltar, Malta and Cyprus...	48	...	59	272	...	41	506	53	4	...	48	...	1,031
U.S.A. and Philippines	265	70	126	47	...	4	2,098	38	15	...	...	45	2,708
Canada and Newfoundland	2,230	2,415	940	1,246	652	2,839	10,224	897	114	40	102	1,193	22,892
British West Indies and British Guiana ...	96	13	294	99	15	4	205	...	28	...	244	16	1,014
Mexico and Central America	16	...	24	...	...	3	93	149	...	...	712	...	997
Peru and Uruguay	12	152	68	...	...	...	37	77	...	...	100	20	466
Chile	363	185	44	17	...	254	1,191	...	2,792	373	23	1,128	6,370
Brazil	1,021	2,095	506	92	130	394	2,516	166	17	...	464	474	7,875
Argentina	1,220	6,406	545	275	78	797	9,173	2,883	390	125	2,176	922	24,990
Colombia, Venezuela, Ecuador and Bolivia...	46	...	2	31	...	...	454	...	...	...	...	...	533
Egypt, North Africa and Persia	154	1,338	190	...	13	72	1,437	440	145	...	237	933	4,959
British West Africa	42	266	58	137	22	568	198	5	313	38	228	42,107	43,982
Rhodesia, O.R.C. and Transvaal	2,234	956	330	855	10	94	2,000	4	602	32	749	694	8,560
Cape of Good Hope	1,083	2,654	794	859	61	215	5,082	267	2,625	7	1,050	369	15,066
Natal	1,356	3,568	732	1,298	...	36	2,910	113	312	47	152	402	10,926
Zanzibar, Brit. E. Africa, Mauritius and Aden	3	69	51	114	21	20	275	31	24	...	2	381	995
Madeira and Portuguese Africa	97	483	172	53	510	90	732	...	34	...	...	58	2,229
China and Siam	355	882	357	707	27	832	788	619	297	162	42	355	5,423
Japan and Korea	1,215	38,840	440	36	229	687	6,642	3,296	1,336	29	...	...	52,750
India	8,257	8,005	4,281	2,760	133	608	13,452	1,436	2,924	157	366	1,360	43,739
Ceylon	159	728	228	68	...	100	813	21	91	...	...	346	2,554
Straits Settlements, Fed. Malay States and Sarawak	966	1,842	568	57	...	264	923	325	97	156	327	456	5,981 1,600
Hong Kong	204	568	88	439	10	...	216	...	16	33	6	20	695
West Australia	25	56	32	249	...	196	137	...	...	...	...	...	
South Australia	660	1,037	197	67	48	136	536	...	58	10	955	661	4,365
Victoria	1,012	3,795	626	3,087	...	298	2,693	171	242	...	644	87	12,655
New South Wales	3,082	8,046	345	1,945	38	1,592	7,138	417	533	77	7,318	3,901	34,432
Queensland	206	456	36	144	12	150	1,161	...	460	...	223	134	2,982
Tasmania	107	...	...	155	...	262	...	...	30	...	...	...	554
New Zealand and Fiji Islands	1,382	1,577	380	538	...	445	5,383	189	201	...	316	119	10,530
Total, £	33,326	94,201	15,751	16,512	2,551	11,982	114,886	17,402	14,420	2,251	27,389	69,226	419,898

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	33	58	...	89	...	48	3,019	180	633	...	1,739	5,799
Germany	5,124	14,080	1,889	10,580	4,850	3,996	59,380	520	2,195	6,784	12,703	122,101
Holland	14	93	13	163	320	...	27	...	16	2	27	675
Belgium	506	984	96	34	34	777	856	111	488	1,152	7,302	12,340
France	289	50	1,144	135	185	658	307	...	1,358	7,181	3,274	14,581
Switzerland	39	1,883	89	29	68	64	1,320	55	12	...	852	4,411
Italy	...	856	6	...	...	...	406	...	...	...	1,142	2,410
Austria-Hungary	...	1,100	...	40	38	...	7	...	16	324	239	1,764
United States	2,035	62	32	215	711	174	9,054	4,073	...	100	165	16,621
Total, £	8,040	19,166	3,269	11,285	6,206	5,717	74,376	4,939	4,718	15,543	27,443	180,702

Additional imports: Spain, carbons, £410; Japan, goods, £45; Canada, goods, £148, machinery, £40.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above ...	6,961	323	...	721	325	...	3,870	...	140	347	...	12,687

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

TOTAL EXPORTS: £419,898. TOTAL RE-EXPORTS: £12,687. TOTAL IMPORTS: £181,345.

THE MAINTENANCE OF TRANSFORMER SUB-STATIONS AND STREET BOXES.

[COMMUNICATED.]

In most of the alternating-current systems of electric light distribution in ordinary town supplies the transformation from the high-transmission pressure to the low-tension distribution voltage is accomplished by means of transformer sub-stations containing one or more static transformers. These are situated either in the basement of a building used for other purposes, or in some cases in specially built chambers placed underground in the thoroughfares. In addition to this, there are always to be found a considerable number of street boxes for inspection and drawing-in purposes, and such static transformer sub-stations and street boxes must be subjected to careful inspection and maintenance, or otherwise, sooner or later, a serious breakdown is sure to occur. As a matter of fact, such underground compartments may be reckoned as either the strength or the weakness of a cable distribution system, according to whether they have been properly designed or not in the first case, and have been kept under an efficient system of inspection and repair. There is a great danger in neglecting this portion of the equipment, inasmuch as it is not so readily accessible as the generating plant at one end and the consumers' panels or fuses at the other; and it may, therefore, be advisable to make some reference to the care which may be bestowed on this part of the installation in order to keep it in good working order.

It very greatly adds to the efficiency of the system if one man, or set of men, is detailed off to be responsible directly to the chief engineer for the maintenance of such street boxes or transformer sub-stations, as the importance of these warrants most careful attention. The duties of such inspectors should be primarily to ensure that every switch, instrument and other piece of apparatus installed should be kept scrupulously clean and in absolutely perfect working order. Slackness in this respect means ultimate breakdown. In addition to this, they should be instructed to take notes as to whether, on any visit to the sub-station or street box, there is any indication of an escape of gas or water into the compartment. If the slightest suspicion of this prevails, the matter should be immediately brought before the notice of the chief, and it should then be the duty of the latter to see that such leakage is corrected in such a way that it will not occur again. There have been too many mishaps through the percolation of gas and water, for which electricity has been blamed, and this is an important point.

A transformer sub-station or street box forms a convenient point for noting the conditions under which the network is operating, and part of the inspector's duties should be, on each visit to any feeding point, to note the output of that feeding point as indicated in amperes on the secondary or low-tension bus-bars, and also the differences of potential existing between the secondary bus-bars, these particulars, together with a note of the date and time of the visit and observations taken being entered in a note-book or log-book kept at the feeding point; in addition, the inspector should enter up the same particulars in his own note-book, so that he may always have them available for reference wherever he may be. In this way two purposes are achieved. The first is that, at every feeding point, a more or less continuous record is permanently kept as to its behaviour and the conditions under which it works, while the inspector has his own report, which he enters on every round of visits, as to the condition of affairs at every feeding point. These notes can be made more valuable if, in addition, careful particulars are given of any unusual occurrence or condition noticed during the visit. If more than one person has access to the chamber, the record at each visit should be initialed by the man making the entry, in order that, at any future time, reference may be made to the man who made the observations. It is almost needless to say that stringent precautions should be taken to see that no unauthorised person enters the transformer chamber, and inspectors should be especially warned not to permit any unauthorised person to accompany them into the chamber when they are making their rounds.

Another duty of the inspector during his visit to any feeding point should be to test the insulation resistance both of the transformers and the circuits which they supply. In most transformer sub-stations it is a rule to install more than one transformer in order to provide means for changing over should a breakdown occur on one of the transformers, and also to allow of the transformers being switched in and out in accordance with the load upon them, in order to cut down, as far as possible, the magnetising or no-load losses of the system. For this reason it is nearly always possible, except, perhaps, during a peak load, to switch out one of the transformers at a time for the purpose of insulation testing, and these tests, which should be entered in the log-book belonging to the feeding point, should include the insulation resistance between primary and secondary coils, insulation between primary coils and earth, and also resistance between secondary coils and earth. By keeping a history of the transformer in this way, it is very often possible to detect tendencies to breakdown of insulation, which, if allowed to remain, might perhaps cause a failure of the supply. In addition to this a voltmeter should be installed on the secondary side of the system with a two-way switch and an off position, so that one terminal of the voltmeter may be connected at will to either pole of the secondary supply. The other terminal of the voltmeter should be connected directly to earth, and the readings of the voltmeter should be logged to furnish an indication of the insulation resistance of the secondary network to earth, which will be useful as a history in determining the behaviour of the cables.

As the transformers and circuits will be protected at the feeding points both on the high and low-tension sides by means of fuses, it is necessary that the inspector should see at each visit that a sufficient supply of spare fuses is always available in case of emergency. Furthermore, he should make sure that the fuses are of the proper size, no more and no less. If this point is neglected there is a great danger of some incompetent person fusing up the transformer and supply circuits too strongly in order to get over a peak or to give himself less trouble due to an intermittent short or fluctuating load. Cases of very serious trouble have occurred owing to an ignorant or negligent man seeking to save himself a little trouble in finding out the real cause of fuses blowing by attempting to mask the trouble by stiffening up the fuses unduly, and the inspector should see to it that this kind of malpractice is checked. Another point he should see to is that the wires giving an earth connection to the sheathing of cables, the cases of the transformers, the iron framework of switchboards, &c., are carefully examined at regular and frequent intervals, inasmuch as it is by no means uncommon to find such earth connections becoming loose or corroded. If there is any doubt at all as to the efficiency of the earth plate or other earth connections, they should also be frequently tested, and it is a very good rule that no earthing connection should be less substantial than tinned copper cables of seven strands of No. 15 S.W.G. wire. The connection between the wires and the parts which need earth connection must be effected in a strong and substantial manner. The point to be remembered by the inspector is that earth connection is a good safeguard against fatality if it is real. If there is any doubt about it the transformer chamber becomes a death trap. Particular attention should be paid to the sheathings of all high-tension cables in the sub-station. These should be earthed at every joint.

There are certain things in connection with the routine of transformer chamber maintenance which are perfectly safe if they are done in the right way, but which if slackness is allowed to creep in, may cause serious trouble, and possibly accident. For example, only an experienced man should be allowed to carry out any work whatever in connection with the high-tension mains, and, indeed, it is highly advisable that no inexperienced person, even if he is in the employ of the supply authority should be allowed to enter a transformer sub-station if it is giving or taking any supply. An experienced man should be employed to clean switchgear, replace or take out fuses, and do any other work

connected with the high-tension supply, and should be instructed always to wear rubber gloves, and any employé neglecting to do so should be instantly dismissed. Moreover, defective gloves should not for a moment be tolerated, and every employé should be instructed to report the matter at once should he find any glove defective, and a stock of new gloves should be kept ready, so that a new glove can be served out at once. It is "Penny wise and pound foolish" to have anything to do with a rubber glove which has any suspicion whatever attached to it. The men engaged in switching and cleaning operations, even of the most routine order, should be instructed that the switches on both the high and low-tension sides of the transformer circuit in which a fuse is to be placed, should be opened—first on the high-tension side, and, then, on the low tension side—in order to avoid any possibility of a fuse, while being inserted in a faulty circuit, closing the circuit and blowing again while the man's hand is anywhere near it. The proper place to close the circuit is at the switch, and when a fuse blows it is just as well to be out of the way of it. Should anything in the way of persistent fuse blowing or any other unusual thing happen it should be the duty of the inspector to report it at once to the chief. Another point with regard to routine work, which should be impressed upon all those engaged in controlling the operation of transformer sub-stations, is to give careful attention to the question of switching transformers in and out of circuit. It is astonishing what a saving of energy from the generating station can be effected by a careful system of switching out transformers on a light load, and switching them in again when peaks come on. Where the load is fairly regular, and can be predetermined as to time and amount the question of switching in and out is comparatively simple, and can be made a matter of routine. Where the supply is subject to violent fluctuations, as, for example, in a town liable to sudden storms, it is necessary to have some means of getting round the sub-stations easily and quickly in order to switch in extra transformers to meet the load, and this can be best done by providing one man, who is an expert cyclist, with a key for the transformer chambers, and keeping this man in attendance at the main generating station (where work can always be found for him to do), so that directly an indication of a peak is shown either by weather conditions or by the ammeters on the main switchboard, he may be despatched round the sub-stations to put in the necessary transformers. It is worth while taking this extra trouble in order to save the magnetising losses in the case of a large system of transformers in operation. In switching transformers in, an attempt should be made as far as possible to give to the transformers an equal amount of work to do, so that they will be operated in rotation as far as possible. This is not always practicable, as in some transformer stations the units are of different sizes, the small one being reserved for day loads, and the larger ones being put in for peaks. Where, however, the system of rotation is possible it should be adopted.

In connection with the maintenance of transformer sub-stations and the network in connection with them, very stringent precautions should be taken to see that a complete system of switching on and off is adopted in connection with the cables. Many mistakes, some of them very serious ones, have occurred in connection with repairs of cables, owing to workmen starting operations on a cable which was supposed to be dead, but which was actually alive either from the power house end or from some feeding point, and for this reason a careful set of rules should be made as to switching on and off. For example, taking the case of cables, the mains engineer should personally see that the circuit switch and fuses have been drawn at the power house end of the supply, and also that the switch has been locked in its off position, and a danger notice hung up on the circuit panel; also a note should be inserted in the station log book of the fact that the circuit is out of commission and must not be switched in. He should make it his duty to personally acquaint the engineer in charge at the time of the fact that the cable is out of commission, and ask him to draw the attention of each succeeding charge man to the same fact. He should then personally see the sub-station inspector and proceed with him to the feeding point to which the cables are connected, and repeat the operations, drawing fuses, locking off, and recording this in the log book of the sub-station. When this is done, every pole of the cable should be bound together with stout copper wire, one end of this wire having been previously connected to an efficient earth, and this wire should not be removed until all operations on the cables have been completed. Some systems have a more elaborate method of earthing cables, but the above is suggested as one method which can usually be adopted in most ordinary systems. After the work is done, the mains engineer will personally inspect the job and make sure that everything is to his satisfaction, and will make the necessary insulation tests, and on a three-phase supply, phase-connection tests. When he is satisfied that everything is in good order, he should, by memorandum, and not by word of mouth, inform the charge engineer at the power house and also the sub-station inspector that the cable may be placed in commission again, and he should also remove the earthing connection which he had previously placed on the cable. It is advisable that he should be present both at the power house and at the sub-station when the fuses are replaced and the cable switched into commission again, in order that, should anything be wrong, he may obtain a first-hand impression of what occurs. Somewhat similar precautions should be taken in any sub-station in which repairs to a transformer or the cleaning of a transformer is taking place. The switches connecting the transformer to the supply both on the high-tension and low-tension sides should be opened and locked off, the keys being given to the man who is in responsible charge of the cleaning or other work in connection with the transformer. The fuses of the high and low-tension sides should also be drawn and an entry should be made in the log of the sub-station that the transformer is out of commission and must not be used.

No one but an experienced person should be allowed in the sub-station or have anything to do with the transformer, and the inspector should personally take all necessary precautions to ensure the workmen against accidental contact with any surrounding apparatus under pressure. Needless to say, the sub-station should be so designed that such accidental contact is impossible without gross carelessness. The inspector should impress upon the workman every danger point in the place before allowing him to commence work. When the work has been done, and the necessary tests made, the man in responsible charge of the work should be allowed to replace the fuses and switch in the transformer again, but only in the presence of the sub-station inspector, after the inspector has personally satisfied himself that so far as he can see these are in good order. When this has been done, an entry of the fact that the transformer is again in commission should be made in the sub-station log-book. These remarks apply to the more or less sectional repairs and maintenance jobs which occur from time to time in all sub-stations. Where, however, it becomes necessary in order to carry out more extensive work, such as reconstruction or extension in transformer sub-stations, there is a danger that inexperienced workmen may be introduced to the compartment. If this has to be done, then all possible arrangements should be made at the power house and at the distributing network, so that this particular sub-station can be entirely isolated, so that while inexperienced men are in it, both the high and low-tension bus-bars can be earthed, and no pressure whatever, either high or low-tension, allowed in the sub-station. Where, from the size or importance of the feeding point, or from any other consideration it is impossible to put the sub-station entirely out of commission, it is necessary from the point of view of safety that during the whole time that an inexperienced workman is in the sub-station he should be under the personal surveillance of the sub-station inspector in order to prevent him from doing anything which might cause trouble.

In the above notes attention has been chiefly paid to the transformer sub-station, inasmuch as it is larger and more complicated than the usual street box. It will be seen, however, that a considerable proportion of the above remarks apply with equal force to street boxes, the only difference being that imposed by the smaller and simpler character of the work involved. It may possibly be thought that in some cases the requirements indicated in the above

notes are too stringent, and that the ordinary mains staff may not be able to cope with the amount of work involved. While this is to some extent true, and while also local conditions may considerably alter the conditions of some of the above suggestions, the main purpose of the above notes is to emphasise the importance of attending very much more strictly than is often at present the case, to that portion of the distribution equipment which is apt to be neglected from its concealed situation and stationary character.

MAGNETITE ARC PROJECTORS FOR ELECTRIC VEHICLES.

By R. E. NEALE.

Enclosed-arc projectors have been considerably used in the United States during recent years, as headlights for electric vehicles. The essential features of all the types used are much the same—a cylindrical shell encloses the mechanism and a single or double solenoid actuates the regulator armature. The lower, negative, carbon is carried by a fixed clamp, and the series ballast resistance is formed by several coils of high resistance wire.

As a result of the steady increase in size and speed of the vehicles, such projectors are no longer sufficiently powerful, and several of the high-speed interurban lines have evolved

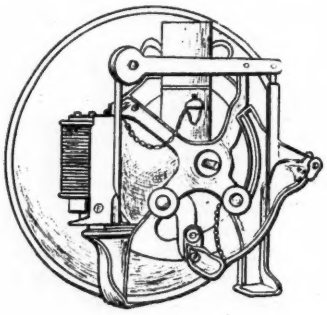

Fig. 1.

special types of arc projector, of which the most interesting employs a Magnetite arc. A block of copper, provided with a hood of non-oxidisable metal, is used as the anode and lasts 2,000-3,000 burning hours. The cathode consists of a thin welded steel tube containing a mixture of iron oxide and

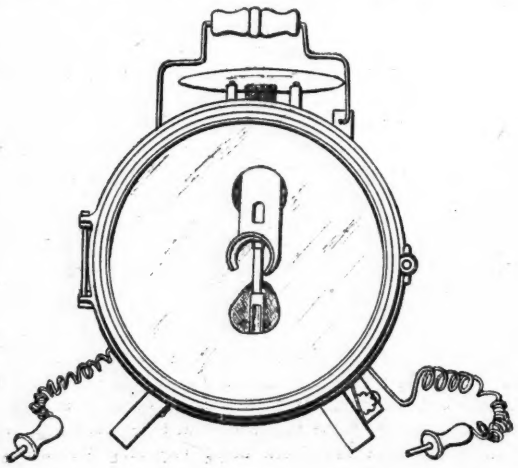

Fig. 2.

other salts; this electrode burns 50-75 hours without replacement. The arc, in which the cathode vapours are brought to incandescence, provides the whole of the light emitted, and the candle-power per watt is approximately double that of the ordinary carbon arc.

Fig. 1 illustrates the general arrangement of the lamp mechanism, which is carried by a framework of galvanised iron, attached to the case by screws. The ends of the electrodes penetrate a parabolic mirror, at the focus of which the arc is permanently maintained. The front of the projector is closed by a glass lens of a form adapted to the proposed use of the lamp. The whole is arranged in easily portable form, and connection is made to the supply circuit by flexible leads with attached plugs; access for inspection and cleaning is thus easily obtained.

Fig. 2 represents a lamp having a parabolic mirror and a chimney intercepting the direct rays; this type is largely used on suburban medium speed lines where crossings and

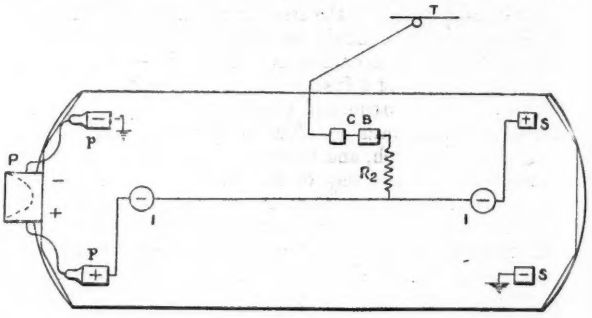

Fig. 3.

curves are frequent. The beam obtained diverges 100° on either side of the axis, and a wide field of view is illuminated.

Certain towns prescribe a maximum intensity for headlights on electric and other vehicles running within their boundaries. These regulations may be satisfied by the use of screens temporarily placed over lamps which are otherwise too brilliant, but a more satisfactory solution is possible, where Magnetite arcs are employed, by simply reversing the polarity of the supply. The arc then continues to burn steadily but with much reduced intensity. Some companies, however, prefer to fit one or two filament lamps in the

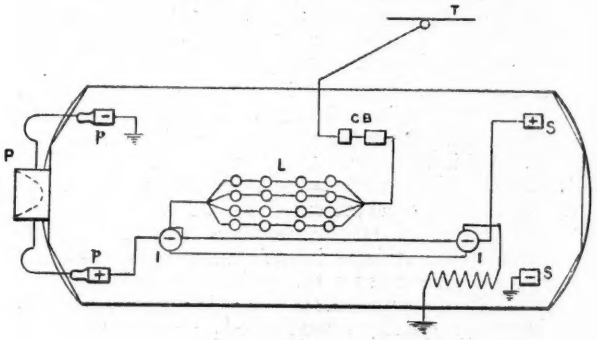

Fig. 4.

projector casing, using these and extinguishing the arc when running within town areas. A single 16-c.p. auxiliary filament lamp is usual in parabolic-mirror projectors, and two, mounted in inclined positions, when Mangin mirrors are used.

An exceptionally robust type of projector, designed for use on high-speed interurban railways, has a spherical mirror and lighthouse-type front lens (with concentric rings). High concentration of light is secured, and it is possible to see the track clearly for 650 yards ahead; as the train can usually be stopped within 570 yards, the power of the lamp is ample.

None of the above types have any internal globe liable to blackening, and involving frequent cleaning and renewal. The front glasses are strong, and so designed as to withstand uneven heating. The burning life of the electrodes is long, and control of the lamps is extremely simple.

In the connection diagrams (figs. 3 and 4), P represents the projector; P P the plug and socket connections; I I the contacts of the main interrupter switch; S S lamp sockets at other end of car; R_2 resistance; L lamps; C B a circuit-breaker; and T the overhead or rail supply. Fig. 3 represents the simplest possible connections, no provision being made for reversing the lamp current. Fig. 4 shows an

arrangement for running the projector in series with incandescent lamps—this being the most economical system available: when the incandescent lamps are to be used alone, the projector is replaced by a substitutional resistance.

REVIEWS.

Calcul et Construction des Alternateurs. By HENRI BIRVEN. Translated from the German by P. DUFOUR. 1911. Paris: Gauthier-Villars. Price 6 fr.

The chief value of this book lies in the part relating to the complete calculations required for the construction of alternators of given output, although a good deal of attention is given to the consideration of the general theory of single and polyphase currents. The book starts at once with the calculation of the sine curve and R.M.S. value of electromotive force and current as obtained by integrating the instantaneous values of each. For arriving at the effective value of the functions on curves other than sine curves, there is a useful table giving different values for the coefficient k (2·22 in the case of a sine curve), with seven various forms of curve. Chapter I concludes with several diagrams of armature windings relating in all cases to machines of the revolving field type. The last 15 pages of the chapter are spoilt by bad binding and printing, the omission of many pages breaking up the calculations completely. Between pages 34 and 48, for instance, eight have been completely omitted, and seven have been printed twice; diagram 33 has a slight omission.

In the second chapter, the author deals principally with the excitation of alternators. Kapp's diagrams and formulæ relating to the dispersion flux of the magnetic system are freely used, the author duly pointing out that the use of such formulæ is entirely dependent on coefficients obtained experimentally from other machines, and that they are applicable only under limited conditions as regards the form of construction of the machine. The methods of regulating the voltage of alternators are touched upon, automatic regulators being rather deprecated on the ground that a very fine degree of regulation is not consistent with several other important factors, including the cost.

Diagrams are given of three methods of compounding for voltage drop, but no mention is made of such well-known systems of regulation as the Heyland and Tirrill automatic systems. In a rather unconvincing way it is recommended that in the case of alternators working in parallel and excited by a common machine, storage battery plant should be installed as a stand-by and for lighting use in case of necessity. Except with a combined lighting and traction plant it is not likely that such a battery installation would be necessary or of commercial advantage.

Chapter III, dealing with the working of alternators in parallel, is more or less a repetition of Kapp's treatment of the subject in "Dynamos, Alternators and Transformers," and introduces nothing new. However, the running up, switching-in, and the conditions accompanying the processes are put in a clear and interesting way, as is also the subject of the periodic oscillations of alternators when connected to the circuit. No mention is made of the steam regulation of engines driving alternators connected in parallel, though it would have been particularly useful to state here the general principle concerned.

In Chapter IV, the subject of the energy losses in alternators is dealt with, and though it is considered briefly, it is put in a form likely to be interesting to students, which is a great point in a work of this kind. Having by now got thoroughly into the subject of the alternator as an independent unit, the author follows up with the two most interesting and useful chapters of the book. These chapters deal in a very complete way for such a comparatively small work, with the construction of alternators and the proportions between the various parts. They include illustrations of various types of machine, with the method of supporting them on foundations, the means by which the magnet coils and pole-pieces are attached to the spider, and calculations of the best proportions of spider arms, shaft and trunnions.

In the second of these two chapters, which concludes the book, the author goes systematically and completely through the electrical calculations, first of all, for a single-phase alternator of 150 KW. output working with a power factor of 0·8. The calculations are given methodically and completely, and would serve as a most useful guide to anyone in the design of machines of comparatively small size. They are followed by a comparison of the proportions, as calculated, with those of an existing 100-KW. single-phase machine built by Brioschi, Finzi & Cie., of Milan. The same process is then gone through for a three-phase alternator of 69 KW., a similar comparison being made with a three-phase machine by the Vereinigte Elektrizitäts Gesellschaft, and with another built by Garbe, Lahmeyer & Cie.

There is an error on page 124 in the formula for the distance between poles, in that on page 139 for the armature current in the single-phase alternator, and on page 140 in the current density in the armature coils.

In general, although there is no original treatment of the subject, which, indeed, is not intended, and although a great deal of the method of calculation seems to have been borrowed from Kapp's work on "Alternators," the book is of real value as giving in a clear, simple way, and consecutively, the calculations to be followed in alternator design. It takes nothing for granted; explains the facts on which each step in the calculations is founded, and has evidently been written by a man who understands the necessity, for the ordinary student, of having such a subject put in the clearest possible way, and who, moreover, has had some experience of the difficulties the student finds in other works of a similar nature.

Simplicity and clearness being the tone of the whole book, it is a great pity that in its present form it has not been carefully revised. It is disconcerting to get thoroughly into a calculation and then to find a page missing, and the many errors in the diagrams and formulæ, though obvious enough, if the latter are closely followed, oblige the reader to be particularly careful in checking them. The discipline may be good, but it leaves an impression of carelessness on the part of the author or the translator, or both. For English readers, the use of a comma instead of a point for the decimal notation, with a point for the multiplication sign, is also a little confusing.

Eléments de Calcul Vectoriel. By C. BURALI-FORTI and R. MARCOLONGO. Paris: A. Hermann et Fils. Price 8 francs.

The present edition of this work has been translated from the Italian. It is a treatise on vector calculation pushed to extremes, introducing many new symbols and methods of operation, with numerous applications to the solutions of questions relating to geometry, mechanics and mathematical physics. It aims to replace the system of co-ordinates by one of vectors. It is pre-eminently a work for the pure mathematician, and is quite unlikely to influence the present treatment accorded to engineering problems by practical men.

Tables Annuelles de Constantes et Données Numériques de Chimie, de Physique et de Technologie. Vol. I. (1910.) London: J. and A. CHURCHILL. 1912. Price 24s. net.

This large volume is published under the ægis of the Association Internationale des Académies by the International Committee appointed by the Seventh Congress of Applied Chemistry, which met in London in 1909. It represents an enormous amount of labour; more than 300 periodicals, besides many other sources, have been consulted for information by a host of abstractors, under the guidance of an authoritative committee, with the aid of contributions from numerous Governments and scientific societies, and the work has considerably exceeded the expectations of the compilers, leading to some delay in publication. Unfortunately, in order to save time, it has been found necessary to omit the alphabetical index from this volume, and although it is hoped to issue the volume for 1911 before the end of this year, containing a general alphabetical index and an index of all the substances mentioned

in both volumes, the omission cannot but be regarded as very regrettable. There is, however, an index of chapters and an analytical table of contents, which, to some extent, mitigate the loss.

Regarding the contents, of course these are not of a nature well adapted for reviewing. There are over 700 pages of tabular matter, relating to the properties and characteristics of the substances included within the enormous range indicated by the title, often accompanied by an extended bibliography. The data are those published in the year 1910, and while they indicate the intense activity of modern research, they do not necessarily represent the most authoritative values —though they are selected with a view to including only results of high accuracy. On the other hand, of course, a large number of the tables relate to properties which have not previously been investigated in detail. The bulk of the work is in French, but headings and tables of contents are given also in English, German and Italian, and little difficulty will be found even by those not familiar with French in understanding the tables. The volume is one without which no scientific reference library can be considered complete, and the printing and binding are of the highest order.

Berechnung von Wechselstromfernleitungen. By Dr. C. Breitfeld. Brunswick: Fried. Vieweg & Sohn. Price 4 M.

This seventeenth volume of "Elektrotechnik in Einzeldarstellungen" is confined to the electric calculations of A.C. transmission lines, and is intended as a simplification of the larger works, such as G. Roessler's, on the same subject.

The problem of long transmission lines is admittedly a fascinating one to the mathematician, but, at the same time, it is one which has fairly frequently to be handled by the practical engineer nowadays, and the theoretical point of view adopted throughout this book makes it unlikely that the actual designer of lines would obtain much help from it.

The physical meanings of the often lengthy formulæ deduced are not clearly explained, if mentioned at all, and the simplified expressions, which are the only ones that most engineers have time to use, are very scantily treated; the important question of their relative accuracy to that of the fuller solutions is hardly touched upon. A good many more explanatory diagrams might also have been introduced with advantage.

As an introduction to the complete theoretical study of transmission lines the book has its uses, but its general utility would be much enhanced, and it would take its place more naturally amongst the other volumes of the series to which it belongs, if the treatment adopted were a good deal less theoretical.

Wiring Calculations and Electric Light and Power Installations. By G. W. L. Patterson. London: Scott, Greenwood & Son. Price 5s. net.

Perhaps the first thing that should be said about this little book is that it immediately extracts from the reader the remark that, Surely such a book would have commanded a big sale many years ago? Its lateness does not, however, detract seriously from its present value, except in so far as its contents can now be found in more or less convenient form in some pocket-books and appendixes to text-books.

The tables and hints given should prove of the utmost value to the wireman and wiring contractor; their value is enhanced by the conciseness of statement and the absence of unnecessary theoretical matter. The writer is evidently of the opinion that an ounce of experimental evidence is worth a ton of theorising, and he has certainly given a vast quantity of data on all branches of wiring. The sections on alternating-current work are specially good, some quite difficult points being cleared up with an ease of diction rarely found in books intended for practical men, and this without lapsing into unscientific or inaccurate statement.

The tables occupy nearly one-third of the book, and are tolerably, but not entirely, free from typographical errors. The table of the electrical and mechanical properties of aluminium and copper is interesting and valuable.

One would prefer to see familiar formulæ and laws given their well-known names on their first appearance in the book —for instance, the time-honoured $c = E/R$ is quoted many times without any mention of Ohm's law; but beyond this, the book has no serious defects.

The Electrical Properties of Flames and of Incandescent Solids. By H. A. Wilson, F.R.S. University of London Press: Hodder & Stoughton. Price 6s. net.

There can be no doubt that among the theories that have been developed during the past few decades none has been more fruitful of experimental investigations than the ionic theory of gaseous conductivity.

Sir J. J. Thomson's part in the conception and development of this theory needs not to be laboured. His have been the suggestions that have occupied the Cambridge School of Physicists with a multitude of problems bearing on all sides of this question. And not only has he directed the many researches carried on in the Cavendish Laboratory and elsewhere, but with his own hands he has laboured continuously for nearly a quarter of a century on ionic problems needing great experimental skill, and still more of that scientific insight and experience—the Philosopher's Stone—which has turned so many apparently negative results into valuable additions to our scientific knowledge.

Chief among the experimenters who attacked the important problems of electrical properties of flames were McClelland, Richardson, Rutherford and H. A. Wilson. The last-named is responsible for the present volume, which is intended "to give a concise but fairly complete account of recent researches," "to present the mathematical theory required in as simple a form as possible," and "to make estimates of the reliability of some of the measurements described." Prof. Wilson has produced a book which is entitled to rank with the other "Ionic" classics of Rutherford, Whetham and Thomson himself.

No single branch of the subject is left untouched, and the hand of one who has been in intimate contact with the very experiments described can be clearly traced throughout the book. Here, too, we have the rare advantage of hearing from one who is in a position to judge something of the importance to be attached to the various kinds of experiments, and at the same time learning the directions in which future research is likely to yield fruitful results.

Chapter III may be cited as typical of the book. The discharge of negative electricity by hot platinum in hydrogen is discussed both experimentally and mathematically. The experiments are described and results given. Then Prof. Wilson, whose experiments figure so largely in this as in many other chapters, proceeds to touch upon his own recent work on the discharge in other gases, and concludes with the suggestive remarks that in the case of some observed peculiar thermionic currents "investigation is needed to find out their cause," and that the effect of other substances on these thermionic currents might yield interesting results if systematically studied. These examples of the true scientific spirit are typical of the book as a whole.

But while one cannot help waxing enthusiastic over the general conception and method of the book, there are some details which one cannot admire. In general the line diagrams are good, but a few seem to have been afterthoughts and ought not to have been included in such a rough and ready form.

Fig. 18 would not grace a cheap elementary text-book; still less does it match its well executed neighbours on pages 75 and 78. The formulæ on pages 65 and 67 should agree but do not, and there are a few minor typographical errors.

The first part of the book is devoted to the study of the discharge of negative electricity by hot bodies in vacuo and in various gases; then follows a chapter on the discharge of positive electricity. The whole subject of thermionic currents is treated mathematically as well as experimentally, and references are given to practically every paper describing original work on the subject.

Then follows a section on the "Conductivity of Bunsen Flames," a subject to which the author returns later in order to discuss the effect of "Alternating Currents and Magnetic Fields," the treatment of the latter being most lucid and complete.

The influence of salt vapours on the electrical properties of flames receives full consideration in the remaining chapter —the longest in the book. The Name Index is useful, but the lack of a Subject Index is regrettable.

Since this book is the only important work on the subject in English, it would be no praise to dub it the best of its kind, but if we adopt as a criterion the very high standard set up by the Cambridge school of writers on Physics, Prof. Wilson's book must take a high place.

NOTES ON INSTRUMENT TRANSFORMERS.

By CECIL TOONE.

Modern conditions of central station generation are such that most large undertakings employ instrument transformers to a greater or less extent, and the importance of these accessories has consequently greatly increased during recent years. In order that the presence of the transformer may be allowed for, once for all, in the calibration of the instrument to which it is connected, it is necessary that the ratio of transformation should be constant under all conditions of load and that the secondary current be but very slightly out of antiphase with the primary current. It is easy to correct for ratio and phase angle in those transformers used with switchboard instruments from which only commercial accuracy is required, and in volt and amperemeters, very accurate correction can be made by aid of tedious calculation. In watt-hour meters, however, it is impossible to compensate automatically for changes in the ratio and phase angle of the transformer with variation in

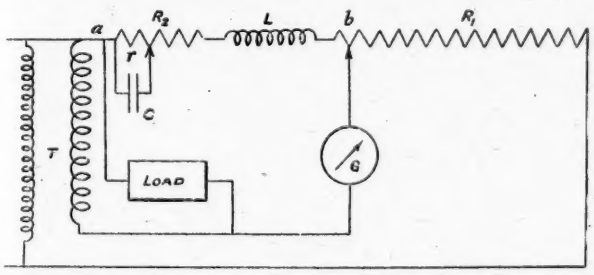

Fig. 1.

the main load and power factor of supply. As a result of investigations into this subject, A. Maxwell, Am.I.E.E., concludes that if care is bestowed on the selection of a transformer for use with energy meters, the accuracy of the latter is not seriously affected by the ratio and phase characteristics of the transformer.

Potential Transformers are generally used on constant voltage systems and with constant secondary load. The ratio can be taken into account in calibrating the meter, but the phase angle can only be compensated for a single power factor of the load; the deviation from ideal phase relationship is generally negligible.

A simple method of testing these transformers (due to Agnew, Am.I.E.E.) is shown in fig. 1. Across the high-tension side of the transformer is connected a high resistance R_1, in series with a smaller resistance R_2, and an inductance L. The low-tension side is reversed across *a b*, through the vibration galvanometer G. Adjusting R_1 and L, till G is balanced, the ratio of the transformer $= [(R_1 + R_2) \times \cos\theta]/R_2$. The phase angle $\theta = \tan\theta =$

$$3{,}438 \text{ P} \cdot \text{L} \left(1/R_2 - \frac{1}{R_1 + R_2}\right) \text{ minutes.}$$

The best means of making the phase angle adjustment is by inductance in series with R_2 and a condenser across part of R_2. The condenser shunt is practically equivalent to a negative inductance of $C \cdot r^2$, and, neglecting the term $(p^2 C^2 r^2)$, the effective inductance of the circuit $= L' = L - C \cdot r^2$ and R_2 is unaffected by C.

Current Transformers of modern design show satisfactory ratio curves down to a load = 5-10 per cent. of the rated value, and the angle by which the secondary departs from its ideal 180° phase relationship with the primary is small over a wide range of current but may introduce serious error at low loads.

The ratio curve usually shows an upward bend at low loads, and by adjusting the light load running of the meter to be 1 per cent. to 2 per cent. fast (at 5 per cent. load), the effect of this alteration in ratio can be compensated without introducing risk of "creeping." A decrease in transformer ratio at low secondary loads is rare but offers no difficulty in compensation. So long as the shape of the ratio curve is

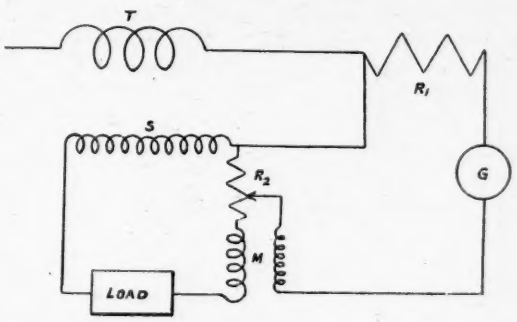

Fig. 2.

similar to that of the accuracy curve of the meter, there is no difficulty in adequately compensating for ratio changes. In order that the ratio curve may be of the desired form, the load on the secondary of the transformer should be a minimum—preferably only the series meter coil and short connecting leads.

Errors due to phase angle cannot be compensated for all values of line load and power factor. In the best transformers, the phase angle remains practically constant over a range of secondary current from 10 to 100 per cent. of rated value, and in any case, the angle should not rise to more than 2° on 10 per cent. secondary load. Tests show the following meter errors due to the stated phase angles (secondary leading), when the line power factor has various values. (The meter runs fast on lagging line power factor and slow on leading line power factor.)

Transformer phase angle.	% Meter error with line power factor:—				
	1·0	0·8	0·6	0·4	0·2
15′	Nil	0·3	0·5	1·0	2·0
30′	Nil	0·6	1·0	2·0	4·2
1°	Nil	1·2	2·2	3·9	—
3°	Nil	4·0	7·0	—	—

The addition of reactance to the secondary circuit corrects the phase angle but alters the ratio curve at a faster rate, hence this method of compensation is not to be recommended. If a transformer is chosen with as small a phase angle as possible and loaded very lightly on the secondary side, the error due to phase angle is not serious for ordinary line power factors.

Transformers with poor ratio and phase characteristics—which category includes most transformers in which lightness has been made a special feature of design—should never be used with energy meters, though they may be quite suitable for operating trip coils and relays.

A method of testing current transformers, uniform with that described for potential transformers, is shown in fig. 2. Current is passed through the primary T and a standard non-inductive shunt R_1, and the secondary current flows through the normal instrument load, the primary of a mutual inductance and a non-inductive resistance R_2, a variable part of which can be included in the vibration galvanometer circuit. R_2 and M are adjusted till G shows no deflection, thus indicating equal (C R) drop in R_1, R_2 and compensation of the phase angle by E.M.F. due to M. The current ratio then $= R_2/R_1 \cdot \cos\theta$, and the phase angle $\theta = \tan\theta = 3{,}438 \text{ P} \cdot M/R_2$ min. As a rule, the term $(1/\cos\theta)$ may be neglected, differing from unity by less than $\frac{1}{2000}$.

The methods of transformer testing described above possess many practical advantages. No polyphase voltage supply, phase shifter or rotating commutator is required. The test can be conducted by a single observer, and a single instrument serves for all ranges of transformers. Without any intermediate change of connections, transformers may be tested in which the phase angle changes from leading to lagging, and the inductance L (fig. 1) is of fixed value, and may be placed where its uni-directional stray field will not affect G. As high a sensitivity as $\frac{1}{10000}$ may be obtained at $\frac{1}{10}^{th}$ load—when testing current transformers under working conditions (*i.e.*, without temporarily over-loading the windings and thus altering the magnetic characteristics of the core)—by using a Campbell vibration galvanometer with a four-turn moving coil of No. 28 wire. A frequency range from 80 to 20 cycles/sec. is covered by varying the length and tension of the suspensions and loading the coil with a tiny brass washer.

OPENINGS FOR FOREIGN TRADE.

By W. H. BOOTH.

While our manufacturers are very eager to keep their shops full of work, comparatively little is being done to increase new outlets for business. The struggle is to get hold of a share of the business which is going. And so our trade representatives are seeking business in South American countries, where there are, perhaps, two to three million people spread over five or six hundred thousand square miles. There is nothing wrong with the countries, for they are fertile, and, as Uncle Sam has shown at Panama, they can be made healthy by abolishing flies, and, it may be added, whiskey, which, despite frenzied claims for its excellent results, is not entitled to many good words, though it may, perhaps, be useful as a temporary aid after snake bite. To hear some men talk, and to watch them act, one would imagine snakes were as prevalent as mosquitos.

South America is a great undiscovered continent. Taken all round, it is the most fertile part of the globe, and is literally a Mesopotamia. It has suffered, and suffers to-day, from bad Governments. Governments are, in their individual members, out for profits, and they are so short-sighted that they will lawlessly grab a shilling to-day rather than wait a year lawfully to receive a sovereign. It was much so at one time in the Argentine, but in some way Argentina was made the investing ground of many millions, and capital flowed in so quickly that it became safe, because too bulky to meddle with, and conferred wealth on the natives quickly enough to put the predatory instincts more nearly on a par with their holdfast instincts. They ceased to risk what they had. The Spanish-American, being a careless have-not sort of fellow, did not mind risking what he had when this was all under one straw hat.

But it is different now in the Argentine. The lesson of the Argentine has not been wholly lost, but it has certainly not been exploited as it might have been, or, perhaps, even yet may be. A cinematograph show of things before and after the coming of capital would be the best commercial pioneer that could be sent through South America from the Caribbean to La Plata.

The continent lacks settlement, transportation and security. As regards products, it is highly mineralised, but prospecting is difficult in a land so much grown over. River transport is excellent, but occasional shallows require attention, and there are shallow bars at river mouths. The Amazon is navigable to big ships almost across the continent, for the river is 79 ft. deep at 2,000 miles from the sea.

The Orinoco is a paltry stream beside the Amazon, yet it is 5 miles wide 300 miles up, and is over 480 ft. deep at the up-river port of Bolivar. But it has a bar of 15 ft., and a rock ridge at one place which only allows of 9 ft. draught for three weeks during the low season.

In itself it is not a power producer, though it could be made to furnish a good deal of small power by way of float wheels, for it has a very rapid current. On its left bank it receives many tributaries, which have few sudden falls, except towards their Andean sources, in Columbia.

The country south of the Orinoco is mountainous; 100 miles south of its confluence with the Orinoco, the Cuchivero tumbles over a 20-ft. fall. The Cuchivero is the smallest of the named tributaries of the right bank, but it is fully as large as the Thames at Richmond. Further in the mountains there are other falls. The river is rated as of the second class, and runs a course of 60 leagues.

The Caroni, a river of the first class, has a considerable fall close above its confluence with the Orinoco, and something has already been proposed, if not done, by way of a hydro-electric scheme, for working the mines of the Yuruari district. It has a course of 185 leagues, and is an immense river, navigable for 160 leagues. Its source is in the Parima Mountains.

Between the two rivers named is the Caura, a river of the second order, which takes its rise in the Parima ranges, as the two streams, Erewato and Merevari. After joining they become the Caura. At Mura there are extensive rapids capable of giving a great power. Further up stream, at Para, the level of the land changes 900 ft. in a few miles, and, since the Caura, with a course of 175 leagues, would make several rivers like the Thames, a rough notion may be formed of what could be made of it by way of hydro-electric works.

Venezuela offers a fine field for colonisation under steady, methodical and scientific management, for crops are heavy, and, of some products, more than one crop a year can be ripened. There are so few railways that electrical working could be employed from the start, avoiding scrapping of old plant, which is so serious an obstacle to electrification at home. There would be power for lighting purposes, estate purposes, saw mills and sugar works.

It is difficult adequately to describe the country, because it is so very fertile, and, though tropical, is not particularly hot. The temperature is high, but this is tempered by constant air movement. It is useless to attempt any systematic colonisation by individuals. Colonisation in a country like Venezuela can best be done under a paternal organisation on the lines somewhat of the British South Africa Co., some powerful company with a liberal charter, that should operate in a number of large sections of land up to 5,000 or 15,000 sq. miles in area.

In these tropical countries it is the worst of folly to dot a few isolated settlers far apart, with no society, no proper transport for their products, and no feeling of security such as would be gained through being a member of a powerful organisation. The Putumayo horrors arise from the operations of unprincipled adventurers in far-away localities. There are no such horrors in the rubber industry of Venezuela, but even there the poor peon is very badly exploited by the padrone system, for he is paid in goods on the truck system, and such goods are priced much too highly, and the result is that the fellow is always in debt to the padrone. All this would be stopped by a good organisation, and it would be more profitable than the truck system. The company would be able to establish stores, and would sell at fair and profitable rates to its own workers as soon as they realised they were not under compulsion, and they would also do a growing trade with others. The country is ripe for such an organisation, and our workshops are ripe for what results such an organisation could accomplish.

The above is no overdrawn picture, and, though written from personal knowledge of only a small part of the South American continent, it is believed to apply very generally to most other parts.

Traders' Needs.—Mr. S. J. Sewell, of 27, Chancery Lane, W.C., an old trade journalist, informs us that, finding that commercial men are determined that Parliament shall next year, by way of a change, seriously consider what burdens on trade can be lessened or removed, and how trade can be fostered instead of repressed, he is editing a 3d. book which will detail not only the laws which injure trade, but also the full needs of all classes of traders. He solicits suggestions of a non-partisan character, commerce, not party, being his sole concern.

ELECTRICAL AUTHORITIES AND THE LAW OF LANDLORD AND TENANT.

[BY A LEGAL CONTRIBUTOR.]

Among the legal questions which trouble those who are responsible for the supply of electricity, that which concerns the title to property and fittings is of considerable importance—especially in view of the fact that hiring agreements have become more common in recent years.

It is clear, in the first place, that apparatus belonging to undertakers cannot be taken by a landlord as distress for rent in arrears. Thus, Sec. 25 of the Electric Lighting Act, 1882, provides that: Where any electric lines, meters, accumulators, fittings, works, or apparatus, belonging to the undertakers, are placed in or upon any premises not being in the possession of the undertakers for the purpose of supplying electricity under this Act, or any licence, order, or special Act, such electric lines, meters, accumulators, fittings, works, or apparatus, shall not be subject to distress or to the landlord's remedy for rent of the premises where the same may be, nor to be taken in execution under any process of a court of law or equity, or any proceedings in bankruptcy against the person in whose possession the same may be.

Had it not been for this section a landlord whose rent was in arrear, might seize any meters, switches, wires, &c., found on the premises when rent is in arrear. There are no cases in the law reports as to the meaning of the section, but there is a very similar section in an Act of Parliament relating to gas. It has been held that the words "any fittings for the gas" have a sufficiently wide meaning to include a gas stove. It may, therefore, be presumed that the words used in the above section would include an electric stove, cookers, kettles, shaving pots, &c., which may have been let on hire (see Gas Light and Coke Co. *v.* Hardy 17 Q.B.D. 619).

A most important provision with regard to electric fittings let on hire is to be found in Sec. 16 of the Electric Lighting Act, 1909. Certain fittings may, owing to the operation of a legal maxim *quicquid plantatur solo, solo cedit*, many fittings which are put up in a house—*e.g.*, wires, wires for pipes, and wood-casing—would become the property of him who owns the house.

Consequently, a motor affixed to the floor would become the property of the landlord. The case of Reynolds *v.* Ashby & Son (1903), I.K.B. 87, illustrates this. Their machines were supplied by the plaintiff on the hire-purchase system to the lessee for a long term of years, of a factory which he had mortgaged. The machines were affixed to the premises by the plaintiff's workmen by means of upright bolts let into the floor, which passed through holes in the bases of the machines, and upon which nuts were screwed. By the terms of the hire-purchase agreement, the machines were not to become the property of the mortgagor until the last of a series of payments for their hire had been made by him, and, if default were made in those payments, the plaintiff was to have power to determine the hiring and remove the machines. The mortgagor failed to make the specified payments. The mortgagees having entered into possession of the factory, the plaintiff gave notice to determine the hiring, and claimed to remove the machines, but the mortgagees refused to give them up, claiming them as fixtures. In an action brought by the plaintiff against the mortgagees to recover the machines or their value, the Judge held, on the authority of Hobson *v.* Gorringe (1897), 1 Ch. 182, that the machines were fixtures, and gave judgment for the defendants.

Owing to the hardship occasioned to hirers of electrical machinery by this state of the law, Sec. 16 of the Electric Lighting Act, 1909, provides that: All electric fittings, lines, apparatus and appliances let by any undertaker on hire, or belonging to any undertakers, but being in or upon premises of which the undertakers are not in possession, shall, whether they be or be not fixed or fastened to any part of any premises, in or upon which they may be situate, or to the soil under any such premises, at all times continue to be the property of, and be removable by the undertakers, and Secs. 24 and 25 of the Electric Lighting Act, 1882, shall extend and apply to all such electric lines, fittings, apparatus and appliances, provided that such electric lines, fittings, apparatus, or appliances have upon them respectively a distinguishing brand or other mark conspicuously impressed or made thereon, sufficiently indicating the undertakers as the actual owners thereof.

For the purposes of this section electric lines, fittings, apparatus, and appliances disposed of by the undertakers on terms of payment by instalments shall, until the whole of the instalments have been paid, be deemed to be electric lines, fittings, apparatus, and appliances let on hire by the undertakers.

Nothing in this section shall affect the amount of the assessment for rating of any premises upon which any electric lines, fittings, apparatus, or appliances are or shall be fixed.

Passing on to consider the relation between landlord and tenant in connection with electric light and fittings, it will be seen that while Sec. 16 above-mentioned settled an important question between company and consumer that question remains at large between landlord and tenant. Suppose, for instance, A takes a lease of a house and installs machinery therein, to whom does it belong? If an electric motor is put up in the basement to drive a washer or a grindstone, does that motor become the property of the landlord at the end of the lease? This question can only be answered by reference to decided cases. For instance, in Hellawell *v.* Eastwood (L.R. 4 Ex. 329) it was held that spinning mules fixed, some by screws to the wooden floor of a mill, and some by screws fastened with lead into holes in the floor, were not fixtures, on the ground that they were affixed for a temporary purpose, the object of the annexation not being to improve the inheritance, but merely to render the machines steadier and more capable of convenient use as chattels. But this appears to have been erroneous both in the use of the word "temporary" and in the object assigned for the annexation.

That this case cannot be much relied upon, appears from the later case of Crossley Bros. *v.* Lee (24 T.L.R. 35), in which the facts were these. A gas engine was let by a hire-purchase agreement to the tenant of certain premises, the engine being attached to the premises in the following way:—A rectangular hole was excavated in the floor, and at each corner of the hole a spindle was set up, being made fast to the ground and projecting 18 in., and the hole was then filled with concrete. The gas engine, which had four holes in its base, was laid upon the spindles, and nuts were placed on the spindles and screwed down. The landlord of the premises distrained upon the gas engine for rent due from the tenant. It was held that the engine was a fixture, and had become part of the freehold and was therefore not distrainable.

The annexation is not temporary if it is intended to last during the interest of the tenant in the premises, and if the machines, although steadied by the annexation and made more useful as machines, are really meant to enhance the value of the mill. Hence, in other similar cases, machines have been held to be fixtures. But a hydraulic press, fixed by bricks and mortar to the floor of a factory, which is a convenience, but not essential to carrying on the works, has been held to be a chattel, and so has a switchback railway, upon the ground that it was erected, not for the purpose of enhancing the value of the land, but only for the purpose of its more convenient use for machinery.

A gas meter fixed in a private house is a chattel, but the retorts, boilers, gas-holders, &c., at a gasworks, which are essential for the purpose of the works, are fixtures.

Physical connection with the land is not essential to constitute a fixture. Keys are so identified with a house as to rank as fixtures; and it is the same with the stone belonging to a mill. Similarly, when machinery becomes fixtures, parts of it which are not fixed, but which are essential to its working are fixtures also.

AUSTRALIAN TRAMWAY COMPANIES AND THEIR EMPLOYÉS.—VII.

The hearing in the Australian Arbitration Court, before Mr. Justice Higgins, of the application of the Australian Tramway Employés' Association for an award fixing by law their minimum rates of pay and conditions of labour, has been continued. In our last report the case for the men was practically concluded, and Mr. Hilton, the chief inspector of the Prahran-Malvern Tramway Trust, was giving evidence for his company. He stated that he had not heard of dissatisfaction among the men as to hours, classification, overtime or holiday. They had six days' annual relief, and four extra days for good conduct. The men had good notice of their days off. It was not possible to keep the lengths of shifts within 8¾ hours. As regards Sunday work, Mr. Hilton contended that the industry was a seven-day one, and that those engaged in it ought not to expect special payments for working on that day. The same rule held in the case of public holidays. Questioned as to the company providing watches, he said that, so far as he could tell from his own observation, every man who applied for a situation had a watch. Mr. H. S. Dix, the engineer and manager of the system, stated that the total increased cost in granting the whole of the men's claims would, on their system, amount to £12,505 per annum. Their revenue last year was £26,314, and their expenditure £20,437. The trust was now building other lines in new districts, and it was probable that for some time the expenses would increase faster than the receipts. Mr. Cameron, the chairman of the trust, pointed out that the trust had met the men's demands as far as they could, in some cases going beyond the men's Union demands, but they could not meet the claims now made.

Mr. Meakin, one of the lessees of the Northcote tramway, was then examined. There were only 40 employés, and there had been no serious complaints made by the men. The undertaking could not pay the demands now made by the men's Union.

Mr. Wilcox, for the Melbourne Tramway Co., wished to speak on the general results of the various demands, but was overruled by the Judge. Mr. Denham, the chief inspector of the line, stated that he thought gripmen ought to get 3s. per day more than conductors. At present the difference was 1s. He considered that if the employment of casual workers was not permitted, both the company and their employés would suffer. He would not agree that preference was given to non-unionists, though the company's dislike to the men's Union was well known. A notice issued by the company warning their employés against joining the Union was put in, and witness was asked if he did not consider it a threat to the men. He said he did not think this was in the minds of the directors.

At this stage of the proceedings, owing to some dispute with his committee as to the way in which the men's case was being conducted, Mr. Prendergast retired from the case, and his place was taken by Mr. A. C. Warton, the general secretary of the men's association.

The traffic superintendent of the Melbourne system explained that it would not be practical, without considerable additions to the staff, to abolish the employment of casual labour.

The Judge expressed the opinion that he was unwilling to fetter the freedom of the management unless it could be shown that it could be done without serious inconvenience to the public. He thought that it rested with the men to prove that the changes they advocated were practicable.

He further considered that during the forthcoming recess every effort should be made by both masters and men to meet and try and come to some mutual agreement. He was growingly convinced this would be the best course, as the agreements need not be identical, but modified to suit local requirements. Mr. Warton, on behalf of the men, stated his willingness to follow this plan, and after a day or two's consideration the employers partially agreed too. After some further general evidence had been taken, and the Judge had emphasised his desire that the case should be settled by mutual agreements rather than a definite binding award, the case was adjourned till the close of the recess.

The appeal against the decision of Mr. Justice Higgins granting to the members of the men's association the right to wear their badge of membership while on duty was argued in the Court of Appeal. It will be remembered that this was the ostensible cause of the Brisbane strike. Counsel on the employers' side argued that this was not an industrial matter, and that consequently it did not come under the Act at all, so that the action was *ultra vires*. On the men's side, it was claimed that it did concern the men, inasmuch as it affected the ordinary course of the industry. After hearing the arguments, judgment was reserved.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

18,458. "Variable-speed driving by electric motor and self-contained mechanical change gear." H. V. James. August 12th.

18,477. "Circuits for the transmission of alternating, undulatory, and pulsatory electric currents." E. F. Furtado. August 12th.

18,479. "Electric secondary clock alarm." G. Lange. August 12th.

18,482. "Electric lamps for vehicles." C. E. Pehrsson. August 12th. (Complete.)

18,498. "Circuit arrangements for automatic telephone systems." Siemens and Halske Akt.-Ges. (Convention date, August 14th, 1911, Germany). August 12th. (Complete.)

18,529. "Telegraphic-transmitters." W. S. Steljes. August 12th.

18,562. "Electrical signalling-device." T. Weiss and T. A. Walther. (Convention date, October 21st, 1911, United States.) August 13th. (Complete.)

18,571. "Electrical accumulators." C. de Sedneff. August 13th. (Complete.)

18,596. "Electrodes for electric arcs." A. J. Boult. (Dynamit Akt. Ges. vorm. A. Noble & Co., Germany.) August 13th. (Complete.)

18,603. "Metal vapour alternating-current rectifiers and similar apparatus." Hartmann & Braun Akt. Ges. (Convention date, March 2nd, 1911, Germany. Divided application on 5,415/12, March 4th.) August 13th. (Complete.)

18,632. "Production and wireless transmission of electrical oscillations." H. Heinicke and M. Jasper. (Divided application on 28,351/11, December 16th.) August 14th. (Complete.)

18,654. "Electric clocks and the like instruments." C. H. Davies. August 14th.

18,655. "Telegraphy and telephony by submarine cables, long-distance overhead lines and the like." J. Schiessler. (Addition to and divided application on 4,061/12, February 17th. Convention date, February 18th, 1911, Austria.) August 14th. (Complete.)

18,676. "Telephone system." J. Baumann. (Convention date, August 14th, 1911, Germany.) August 14th. (Complete.)

18,677. "Telephone system." J. Baumann. (Convention date, August 14th, 1911, Germany.) August 14th. (Complete.)

18,689. "Arc lamp electrodes." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 14th.

18,746. "Electric cranes." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 15th.

18,747. "Electric rectifying apparatus." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 15th.

18,764. "Electric lighting and ignition apparatus of motor-vehicles and the like." B. Brooks and W. Holt. August 16th.

18,777. "Brush gear for dynamo-electric machinery." Lancashire Dynamo and Motor Co., Ltd., R. S. McLeod and J. H. Wild. August 16th.

18,809. "Apparatus for the measurement of electrical energy." H. Gottschalk and H. Aron Elektricitatszahlerfabrik G.m.b.H. August 16th. (Complete.)

18,810. "Electric meters." H. Gottschalk and H. Aron Elektricitatszahlerfabrik G.m.b.H. August 16th. (Complete.)

18,847. "Electric clock systems." A. R. Upward. August 16th.

18,848. "Electric clock systems." A. R. Upward. August 16th.

18,889. "Device for locking electric incandescent and like lamps in their holders." W. H. Lowth. August 17th.

18,893. "Means for producing magnetic or electric fields." M. Plohl. (Addition to 15,774, 1912. Convention date, August 18th, 1911, Austria.) August 17th. (Complete.)

Spain.—On the authority of the German Consul at Barcelona, the *Nachrichten für Handel* (Berlin) states that there is a large demand in Spain for electrical apparatus, such as dynamos, motors, incandescent lamps, transformers, &c., and that there are excellent opportunities for doing business, especially in the case of the lighter machines weighing up to 8 cwt., as well as in the case of small electric fittings. Particularly noticeable is the great increase in the use of electric incandescent lamps, in which it is stated that there is a large import trade to be done, in spite of the increasing number of works manufacturing these articles in Spain. —*Board of Trade Journal.*

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911.

Electrolytic Cells. R. Threlfall. 10,142. April 26th.

Fusible Cut-outs for Controlling Electric Circuits. V. Hope. 14,803. June 26th.

Application of Radioactive Phenomena to Telephony. A. Vojen. 17,027. (Convention date, August 30th, 1910.)

Automatic Electric Burglar Alarm working by the Opening or Short-circuiting of its Protective Circuit, and fed by a Double Circuit connected to the Two Terminals of a Single Battery producing a Constant Current. H. C. Basuyau and V. A. Leroux. 17,086. July 26th.

Electric Motors and Dynamos. T. L. R. Cooper. 17,716. August 3rd.

Automatic Telephone Exchange Systems. Western Electric Co. (Western Electric Co.) 18,648. August 18th, 1912.

Regulators for Electrically-driven Ring Spinning and Doubling Machines. Siemens Bros. Dynamo Works, Ltd., and Kieffer. 19,083. (Addition to 23,641 of 1910.) August 25th.

Speed Regulation of Electric Motors. J. Wagner. 19,369. August 30th.

Receiving Apparatus for Use in Radio-Telegraphy and Telephony. A. de C. Bower. 19,829. September 6th.

Mercury Jet Interrupters. F. W. W. Baker and G. Pearce. 25,860. November 26th.

Switches for High-tension Electric Currents. Marconi's Wireless Telegraph Co., Ltd. (Entwistle.) 26,153. November 22nd.

Electric Maximum and Minimum Excess Voltage Switches. E. Eisemann and E. Eisemann & Co. Ges. 27,729. December 9th.

Electric Door-Operators. T. Nakahara. 28,488. December 18th.

Dynamo-Electric Machines. A. Juston. 28,750. December 20th. (December 27th, 1910.)

1912.

Receiving Apparatus for Electric Oscillations. Ges. fur Drahtlose Telegraphie. 2,383. January 30th. (March 14th, 1911.)

Electromagnets. D. E. Barnes and A. A. G. Jensen. 2,702. February 2nd.

Brush-shifting Mechanism for Dynamo-electric Machines. British Thomson-Houston Co. and Young. 4,688. February 24th. (February 24th.)

Negative Electrodes for Electric Searchlights. Geb. Siemens & Co. 4,789. February 26th. (April 28th, 1911.)

Insulators for Telegraph, Telephone and other Electric Wires and Cables. T. Taylor. 5,053. February 29th.

Suspension of Overhead Conducting Wires for Electric Railways. A. G. Bloxam. (Bergmann-Elektricitats-Werke Akt.-Ges.) 6,670. March 12th.

Method of obtaining Electricity from the Air. Johannsen. 7,263. March 25th. (March 25th, 1911.)

Germany and Electrical Export Trade.—Commenting on the recent progress of the German electrical machinery industry, which represents one-third of the national production, and in particular of the export trade, the *Electrotechnische Zeitschrift* points out the misleading character in this case of round figures, as a large portion of the cost of electric installations is represented by non-electric machinery, such as boilers, engines, rails, cars, &c.; also by accessory objects, such as porcelain insulators, carbons, accumulators, standards, &c. Of a normal month's shipments of electrical exports, less than half are represented by electrical machinery, fully two-thirds being composed of cables, lamps, carbons, accumulators, and accessory material. In electric installations generally, strictly electrical machinery—dynamos, transformers, motors, &c.—constitute actually only one-tenth of the total outlay. In this relatively restricted field, nevertheless, German industry has made great strides, and as regards the foreign trade, by dint more especially of, judicious capital investments. "There is," says our contemporary, "no other (German) industry which has made, and still makes, such large investments of capital abroad as the electrical. We need only to consider the foreign investments of the big German banks, or of the two great electrical concerns, A.E.G. and S.S.W. and their daughter companies, or the share of the Felten & Guilleaume concerns in the trans-Atlantic cable companies called into being by them, to recognise what German capital and German enterprise have effected abroad. The German electro-technical industry has everywhere abroad where a possibility was offered, and where the anti-German animus or tariff barriers were not insurmountable, and especially on the European Continent and in South America, created the largest of installations. In English South Africa, by the lucky combination of German and English capital, the way has been opened to German industry, of which the Great Victoria Falls power station is only one example; albeit the entry of our manufactures into English Colonies generally is much handicapped by the preferential tariff which the Motherland enjoys. In none of these lands, as indeed universally, are we loved, and products "Made in Germany" are only taken there when they are actually better, and the personal advantage of the buyer stills his national hate. North America will always be a closed field to us, for a lightening of the import tariff—as our exclusion from the San Francisco Exhibition also showed—will never be made. North American industries suffer too much from excessive over-production to be likely to facilitate the competition of one of their largest world competitors. From the foregoing it may be seen that the German electrotechnical industry, especially in the last decennium, has attained respectable dimensions, and it may be concluded that, with the inclusion of new fields, as, for instance, that of main railway construction, a steady growth is assured.